THE

ELECTRICAL REVIEW.

VOL. LVI. FEBRUARY 10, 1905. No. 1,420.

ELECTRICAL REVIEW.

Vol. LVI.] CONTENTS: February 10, 1905. [No. 1,420.

	Page
Electricity in Mills	209
Some Tests Conducted with an Electrolytic Rectifier and Motor-Generator (*illus.*)	211
Wireless Telegraphy and the Empire	212
A Business Letter from Japan	213
Correspondence	213
Parliamentary	216
Legal	216
Our Legal Query Column	218
Business Notes	218
Electrical Installations of the Natal Government Railways, South Africa (*illus.*)	227
Electrical Development at Niagara Falls, Canada (*illus.*)	231
Electricity Supply Accounts	234
City Notes	234
Stocks and Shares	238
Share List of Electrical Companies	239
Market Quotations	240
The Future of Railways (*continued*)	241
The British Engineering Industries and the Fiscal Inquiry.—II.	242
More about Electrical Development in Canada	243
Institution of Electrical Engineers:— Birmingham Section	244
Faraday Society (*illus.*)	245
Acyclic (Homopolar) Dynamos (*illus.*)	246
Tramway Construction and Equipment	248
New Patents Applied For	248
Published Specifications	248

THE

UNIVERSAL ELECTRICAL DIRECTORY

1905 Edition

NOW READY.

PRICES, POST FREE:

In Great Britain	14s.
British Colonies	15s.
U.S.A. (duty free)	18s.
Other Countries	16s.

Order at once.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. *Established* 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone No. 933 Holborn; 4425 Central.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, AND HAS

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free, per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

ELECTRICITY IN MILLS.

IT is frequently assumed that the Lancashire cotton mill, with its machinery arranged in a comparatively compact form, does not offer any field for the introduction of electrical driving. The very compactness of mills of this description, combined with the fact that most of the machinery is running at full power throughout the day, has in many quarters been deemed sufficient to prove that the existing method of power transmission—one or more large mill engines driving the various shafts by means of ropes or gearing—is the simplest, cheapest, and most economical way of achieving the end in view.

It is certainly true that under these conditions electrical driving does not show to the best advantage; yet it is well to bear in mind that many similar mills in America and on the Continent are motor-driven throughout, whilst in Lancashire there has not yet been any practical experience of a mill entirely driven by means of electric motors.

The advantages of motor driving under the prevailing conditions are not very apparent to the layman, and can only be brought out in their best light by actual trial, and for this reason electrical engineers in America owe much to the fact that in many of the first mills electrically equipped, cheap water power was available, which in itself warranted the adoption of electrical driving. Having once tasted of the fruits of electrical transmission, mill-owners in that country were not slow to adopt similar systems, even in those mills where power was only available by installing special steam generating plant. Whilst in this way electrical driving has come to be looked upon as common practice in America, sight should not be lost of the fact that many of the Lancashire mills are working under extremely economical conditions—more economically, most probably, than prevail elsewhere—and that it remains for advocates of electrical driving to prove that they can give better results, whether in economy, increased output, or first cost, than are being obtained at present.

The paper read before the Manchester Section of the Institution of Electrical Engineers, on January 17th last, by Mr. H. W. Wilson, entitled "The Electrical Operation of Textile Factories," together with that read by Mr. Woodhouse at Leeds a month earlier, and the discussions following both papers, are of interest as showing what results the electrical system has to compete against.

The consensus of opinion would seem to be that an economical mill engine cannot be surpassed from the point of view of economy, by generating electricity and driving the various floors or machines by separate motors. In other words, the weekly coal bill will not be reduced by adopting electrical driving, and the advantages in favour of electricity have to be sought for in other directions.

The first cost of an electrically equipped mill, including the necessary generating sets, is somewhat less than that of a mill arranged for being driven off one engine, due to

savings made by being able to dispense with the rope-race, long lengths of connecting shafting, &c., and this advantage should command attention when new mills are being laid down. Then, again, a perfectly steady drive is essential if "broken ends" are to be avoided in spinning the cotton—this being one of the principal sources of loss in every mill—and it is found that a steadier drive is obtained where motors are used for driving the shafting, than is possible in mills driven off the ordinary mill engine. For this reason it is found possible to run the machinery at a higher average speed than is possible where some margin in speed has to be kept in hand to allow for the irregular turning effort of an ordinary low speed engine, and, in consequence, an increased output is obtained from mills electrically driven. In the case of weaving, the increased output is put at 4 per cent., whilst, in the case of spinning, up to 8 per cent. increase in the output seems possible.

Summing up, the chief advantages in favour of motor driving would therefore seem to be, first, a saving in first cost, and second, an increased output from the mill, due to the steadier drive obtained from electric motors; and these two advantages alone should be sufficient to command the attention of those laying down new mills.

A point which raised considerable discussion after the reading of Mr. Wilson's paper was whether, having decided on adopting electric motor driving, mill-owners should generate energy themselves, or purchase it from one of the power distributing companies serving their district. Representatives of both the Lancashire and Yorkshire power companies were present, and took part in the discussion, but it cannot be said that they were able to make out much of a case for the purchase of power, in the face of figures which were given as obtainable by mill-owners themselves. The chief argument in favour of purchasing from the companies would seem to be the capital saving which the mill-owners can effect, thereby enabling them to spend this extra capital in their own business.

The whole thing resolves itself into a question of costs, and the shrewd Lancashire mill-owner is not likely to be tempted to save his capital, or to put it into his own business in the form of extensions to his mill, if the cost of energy purchased is excessive, and if the difference between the figure at which he can generate his own power, and that which he has to pay for it from an outside source, is an excessive annual charge on the capital necessary for providing this power.

Trade may be bad in Lancashire, but capital is usually to be found if the returns justify its expenditure, and there is no man more alive to the value of economies in his mills than the Lancashire mill owner. He is not an engineer, but he appreciates more fully than many engineers the importance of low power costs per lb. of yarn spun.

The Britisher Abroad.

In this issue we publish two articles which are deserving of careful study from those who are anxious for the full measure of foreign electrical and other trade to come to the British manufacturer. In our further notes on Canadian electrical development, and also in the extracts from a business letter from Japan, will be found a few criticisms, emanating from men who are daily in close touch with these two markets. The writers are men who know, from practical experience, some of the difficulties that the Britisher has to face, and knowing what they do of British methods in commercial negotiation and warfare, are anxious to utter a word of warning regarding certain imperfections which characterise the attempts at enterprise made by some of our manufacturers and traders and their agents. Our means for examining into the extent to which these strictures are deserved, are very meagre; we can only ask those who are interested in electrical trade with foreign countries to thoroughly digest the criticisms, and profit by them in their future action.

On Electrical Exhibitions.

Electricity works engineers and managers have of late shown commendable activity in the direction of local electrical exhibitions. This we regard as an essential feature of any up-to-date electricity supply system which is endeavouring to popularise its commodity with the local ratepayers who are its prospective consumers. A well-arranged and properly advertised display of lighting and heating apparatus and motors applied to the driving of everyday machines, is bound to be attractive at the present stage of electricity development, and it must also have a distinct educative effect upon the great bulk of the community who do not know what electricity can do and is doing. Further, it brings the ratepayers into closer touch with the progress of a concern in which they are practically shareholders. Recent announcements have shown that not only are some of the leading municipal committees holding, or making arrangements to hold shortly, such exhibitions, but several of the enterprising companies are taking similar measures. Indeed, in one case a company which has the control of a large number of supply systems in different parts of the kingdom, is running a travelling electrical exhibition which with facility can be taken from place to place throughout the year. We have heard sufficient from electricity works engineers to judge that these local displays when, as we say, properly arranged and pushed, cannot be regarded as money thrown away.

But we have heard that there is another proposal on foot just now of, perhaps, greater import to the electrical industry. No doubt the recent big gas exhibition at Earl's Court has had something to do with the origination of the idea, which is this: to hold an electrical exhibition in London on extensive lines under the auspices of the representative body of electrical manufacturers, and with the co-operation of many central station engineers in different parts of the kingdom. The proposal, it is true, has not yet gone beyond the embryonic stage, but it may be carried further at a meeting which is to be held on Wednesday next week, at 2.30 p.m., at the Hotel Cecil. While such an exhibition may be well-timed, and may bring highly beneficial results to the electrical industry, it should not be supposed that it can in any way take the place of the small local exhibitions to which we have just referred. These have a function of their own—to bring electricity and its advantages *prominently* before the general public, who would not dream of going many steps out of their way to inquire about the matter—far less of going to London for the purpose.

It will, no doubt, be borne in mind in the course of the deliberations, that this is the year of the Electric Tramways and Railways Exhibition, which is to open in July at the Agricultural Hall, Islington.

Company Meetings.

Some time ago (Electrical Review, October 23rd, 1903) we felt it incumbent upon us to refer to the much-to-be-deprecated practice of many financial and other papers accepting payment for the publication of reports of company meetings, and, at times, other matter. Everything of this description which is paid for, is, to our mind, advertisement, and should be clearly shown to be such, otherwise it is likely to be misleading to the public. No journal can maintain an independent attitude and give impartial, and, therefore, valuable criticism, unless it refrains entirely from the practice. Our own attitude in such matters ought to be pretty familiar to our readers by this time, but even nowadays we occasionally receive letters from different parts of the country requesting us to publish such and such an item of news, and inquiring our charge for this accommodation.

It is not only the Press which is to blame for the hold which the practice of paying for the publication of meeting reports has obtained; the companies which give it their acquiescence are at fault as well. We are glad to see that the *Times* has spoken out plainly in regard to this matter, and we would suggest that the secretaries of all electrical and allied companies should very carefully scan its two articles which appeared on Wednesday of this week. We wish the *Times* success in its crusade, and believe that it will have the approval and support of every journal of honourable standing and reputation.

SOME TESTS CONDUCTED WITH AN ELECTROLYTIC RECTIFIER AND MOTOR-GENERATOR.

By HORACE BOOT, M.Inst.E.E.,
Consulting and Resident Engineer to the Tunbridge Wells Corporation.

A short time ago I had to make comparative tests of the electrolytic rectifier *v.* an alternating current motor driving a direct current dynamo, for the purpose of charging the accumulators of a large electric car. The amperes required for charging were 50, and the voltage 118 when the cells were fully charged.

A 9-B.H.P. alternating current motor and Siemens continuous current dynamo coupled direct were available, but it was found that 9 H.P. was insufficient for this purpose, and I therefore advised an exchange for a larger motor, or the adoption of the Nodon rectifier (sometimes called an electric valve).

The makers of the alternating current motor considered that nothing less than a 12-B.H.P. one would be sufficient for the purpose, although the continuous current dynamo showed an efficiency of 78 per cent. on test. It was therefore apparent that the amount of energy taken from the alternating current mains, and measured by the supply meter, would be about 12 units per hour, which shows an actual efficiency of 49·1 per cent. after allowing for losses in the motor and the losses in the dynamo. The mechanical losses were negligible, owing to the motor being coupled direct on to the dynamo shaft.

The cost of the plant to undertake this work would have been, if an alternate current motor were used :—

The cost of a 12-H.P. motor	£77
The cost of a dynamo to give 50 amperes at 120 volts	60
Foundations, fixing, &c.	3
Switchboard for operating the alternating and continuous sides	15
The total cost of this plant being	£155

The writer then decided to consider the installation of a "Nodon" rectifier, and found from tests he conducted with this rectifier, that it would give 50 amperes at 118 volts continuous current, for an expenditure of 9 units per hour, showing the total efficiency to be 65 per cent.

The capital outlay involved, as compared with the motor-generator, would be :—

"Nodon" rectifier	£43
Switchboard for same	15
Transformer (or economy coil), with five-way switch	10
Total	£68

For the benefit of those who are not familiar with the latest type of electrolytic rectifier, a brief description may be pardonable. The valve in question consisted of :—

Four lead cells with terminals at the top, the cells each containing a plate 12 in. long × 6 in. deep × $\frac{1}{8}$ in. thick of an alloy of zinc and aluminium. The four lead cells are mounted in a polished teak frame, and there are two supporting rods on which the aluminium plates can be raised out of the liquid, or lowered into them. The cells are filled with a saturated solution of phosphate of ammonium up to within 3 in. of the top, so that it will be seen that the whole combination is exceedingly simple, cheap and effective. There is nothing to get out of order, and it is far preferable to moving machinery, especially when it is remembered that this apparatus in nine cases out of ten has to be worked by an ignorant man. The size of the apparatus overall is 3 ft. 9 in. long × 2 ft. 4 in. broad × 4 ft. 10 in. high.

The course of the alternating current is as follows :—It passes in the positive direction from the plate of aluminium to the lead cell, where a film of phosphate of aluminium and zinc is formed ; this film offers an enormous resistance, and opposes the passage of the current, but if the alternating current desires to pass in the opposite direction—that is to say, from the lead cell to the aluminium plate, the resistance of the film is removed, and the current passes readily. It is quite evident that the two semi-phases of the alternating current will be in the same direction, and can therefore be utilised. Below is a diagrammatic sketch of the connections of the rectifier.

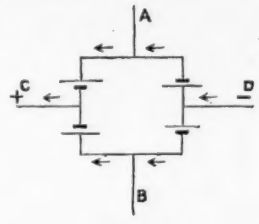


Fig. 1.

The terminals A and B represent the alternating current terminals, and C and D the continuous current terminals. The thin long strokes represent the lead cells, and the thick short strokes represent the aluminium plates.

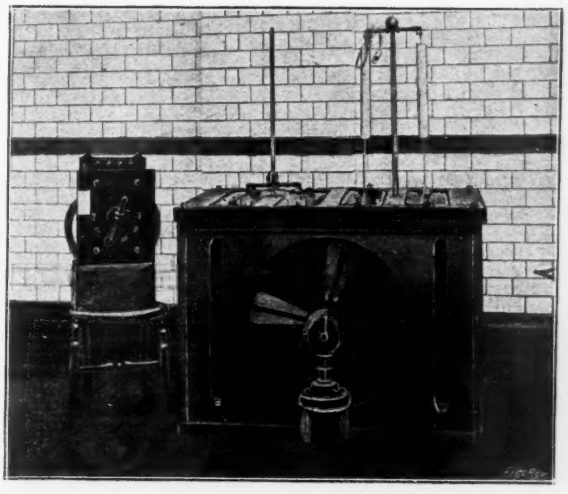


Fig. 2.

The rectifier, when made up, has a very business-like appearance, and the writer has taken a photograph of the actual rectifier in use, which is reproduced in fig. 2.

Fig. 3 represents an electric brougham and electric shooting car being charged by this rectifier.

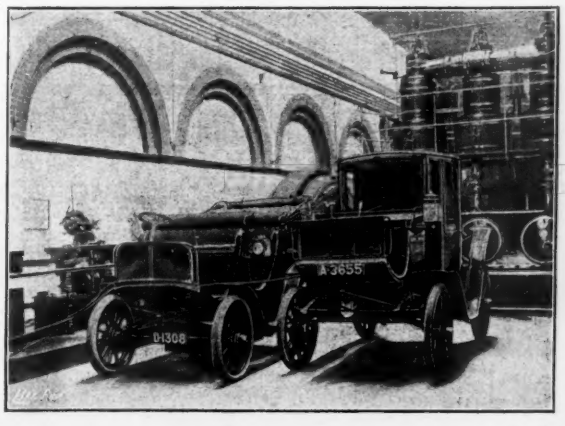


Fig. 3.

In the sketch (fig. 4) the pressures before and after conversion will be seen, starting with the alternating current bus-bars, the pressure between which is 220 volts, an economy coil is used with steps to regulate the pressure, the maximum being 126 volts in this instance, which is the pressure at the

alternating rectifier terminals A and B. The pressure between C and D available for charging the cells is 118 volts.

Owing to the writer's endeavour to obtain the highest efficiency possible, a resistance was discarded, and it was found unnecessary, as the rectifier worked perfectly.

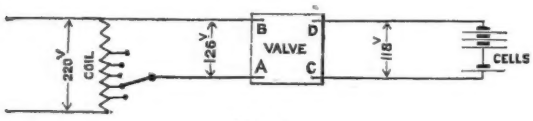


Fig. 4.

For the purpose of conducting an efficiency test on this rectifier, the whole of the energy used was measured by an Aron watt-hour-meter connected to the 220-volt alternating side, and another continuous current Aron watt-hour-meter was connected to the continuous current side of the rectifier, and readings were taken every quarter of an hour for a period of nine hours; the results were carefully checked and plotted on squared paper. Referring to fig. 5, the efficiency, temperature, in-take in Board of Trade units, and out-take in Board of Trade units, curves are shown; the efficiency includes the losses of the single winding transformer that was used: in other words, it indicates the amount of energy the consumer would be called upon to *pay* for to the supply authority, for charging his car cells off the alternating current supply mains at his own house.

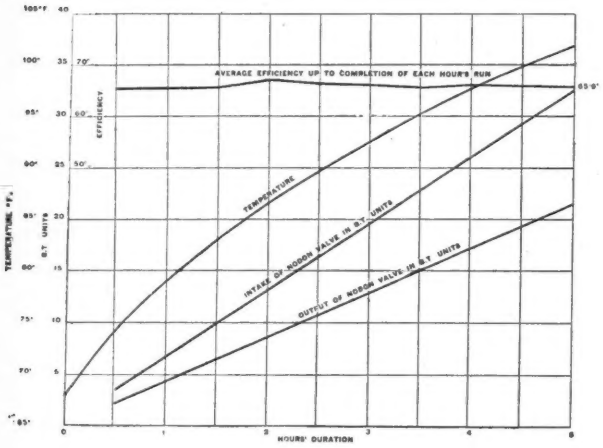


Fig. 5.

The efficiency of the rectifier was found to be in no way affected, no matter how long it was used continuously, provided the temperature did not exceed 120° F., above which temperature the efficiency of the rectifier fell off at an alarming rate. The makers, in the larger sizes, provide a small cooling fan driven by the continuous current from the rectifier, to keep the lead cells cool, by creating a draught of cold air around them, and when this is done it is found that there need be no fear of excessive temperature rise. The efficiency curve includes the losses in the economy coil as well as the energy used to drive the fan motor, so that the results are the net efficiency.

These rectifiers, or rather similar types, have been in use for some time, and show no signs of severe or costly depreciation. The rectifier on which these tests were conducted has now been in constant use since October 14th, 1904, and shows no signs of any deterioration. There is a certain amount of evaporation taking place in the cells, but this is made up by adding distilled water, and occasionally (but up to the present it has not been necessary) new solution, which, however, is quite inexpensive.

The writer was curious to know whether the effect on accumulators when charging them by this method would be the same as charging them with an ordinary dynamo, that is to say, whether it would have any depreciatory effect on the cells, and the reply given by the Electrical Power Storage Co. is somewhat interesting, it being in effect that "they did not see any reason why it should make any difference whatever."

The instructions for working are simple. When the alternating current is switched on, a slight gaseous escape should be noticed, and if this is not taking place, the supply should be switched off and the electrodes rubbed with a piece of wood or glass-paper until they assume a light grey colour. The temperature of the solution should not exceed 50° Cent.

When the charging has been completed, the current can be switched off, and the plates should be lifted out of the solution, as, if they are left to stand in the solution and the current is switched on again later, there is a heavy rush of current, and the rectifier will take some time in starting. This can be avoided by sliding the plates up on the rods out of the solution when finished with.

WIRELESS TELEGRAPHY AND THE EMPIRE.

By JOHN MUNRO.

As our Government, in common with others, is now establishing wireless telegraph stations round the coast, it may not be amiss to consider the extension of the system to the whole Empire. There are submarine cables to the more important parts of the Empire, but many of them touch at foreign stations, and are liable to seizure in time of war. Cables may also be cut by hostile ships. The wireless telegraph cannot be cut. It may be tapped, but the messages cannot be prevented from getting to their destination. Moreover, it has been stated that the Government has purchased from an inventor a mode of secret correspondence by a cryptogram which baffles tappers. It would also appear from reports of experiments and progress that some success in tuning circuits against interference has been attained, and it is likely that further advances will be made in this direction.

It cannot be denied that the wireless telegraph is already capable of supplementing cables as an additional link of communication in time of war and as a means of directing ships at sea. The recent crisis with Russia and the war in the Far East have shown its value in ordering ships of war. Actual trials have proved that Poldhu can communicate with ships 1,500 miles away or more. Messages from America all the way have been published in the *Times* newspaper. Moreover, the United States Government has undertaken to install a wireless telegraph from Florida to Panama, with circuits over 1,000 miles in length. These facts are important for our purpose. It is not here a question of regular and constant communication so much as the transmission of occasional and emergency messages for the Imperial Service.

It has been publicly stated that Poldhu has actually sent messages to Gibraltar, 1,300 miles or so, therefore a similar plant at Gibraltar could not only communicate with Poldhu, but with Malta, about 1,100 miles, and a station at Malta could reach both Gibraltar and Cyprus, or if desired, Port Said. The stations at Gibraltar, Malta and Cyprus, all on British territory, would also reach British warships or other vessels in any part of the Mediterranean. Stations at Cyprus or Port Said, and Aden, not to mention other ports, might cover the Red Sea. There are British islands which might serve as intermediate and relay stations between Aden and Bombay. There are others which would bring Calcutta into touch with Burmah and Australasia. The Seychelles, Mauritius, and various British islands of the Indian Ocean would connect Australia with South Africa on the one hand, and South Africa with Aden on the other. With regard to Hong Kong and Weihaiwei, they might be reached by sea if certain cruisers were fitted with powerful plant to act as relays at need in the chain of communication. Such cruisers might, in fact, serve as temporary links where permanent stations on shore were undesirable or impossible.

Turning to the western hemisphere, and keeping in mind Imperial requirements, it is obvious that a station in the Azores would be valuable, since it could be reached from Cornwall or Gibraltar, and, in its turn, could communicate with Bermuda on one hand, and our West African

possessions on the other. With the help of St. Vincent, Ascension, St. Helena or other British possessions the system might be extended to Cape Colony. Such a station in the Azores would be provided by the Island of Canto, now offered for sale, and the Government might be well advised to purchase it. The advantage of Bermuda is, that it might communicate with Halifax, Nova Scotia and the Bahamas in the West Indies. The Bahamas could be connected through our West Indian Islands with Demerara on the south and Honduras on the west. Lastly, Honduras, through stations on the Galapagos and other British islands of Oceania in the Low and Cook's Archipelagoes or with the aid of ships, if necessary, might communicate with New Zealand—that is to say, Australasia—thus completing the girdle of the world. In such a way a chain of temporary or permanent stations for wireless messages might be established throughout the Empire.

A BUSINESS LETTER FROM JAPAN.

We have received from one of our London readers an interesting letter which has been sent to him by a correspondent in Japan. As some of the remarks have a direct bearing upon the future of electrical enterprise in that very up-to-date Empire, we make an extract or two therefrom. The writer says :—

"I expect things will go ahead tremendously after the war ; in fact, all of us out here are of the same way of thinking, as they propose to give Europeans equal rights with the Japanese next year (1905), which means that there will be a large inrush of capital to work the only partially developed mining resources of this country, where they have the benefit of very cheap labour. Up to the present, want of security for one's money on account of one being unable to acquire property, and therefore hold mortgages, has prevented foreigners from investing capital here, as they otherwise would have liked to do."

The correspondent continues:—

"The Americans will be the people to derive the benefit from all this, as the British firms are so afraid of spending a penny to gain any business, and we are continually losing ground over here on account of this. It is very difficult for the Japanese to judge of the importance of a firm which is established so far away as England, and they can only go by the offices and general appearance of the way the Agency is run over here. Naturally, if it is run on cheese-paring lines, they will be inclined to think that it is not of much importance, and as the silver key has a lot to do with business out here, they will not put business before those who will not entertain them and otherwise give them a good time."

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

On Technical Literature.

I quite agree with "M.I.E.E." in what he says on this subject in your issue of February 3rd, p. 170. My experience has been much the same as his with students and text-books. I always insist on my students doing a good deal of private reading, as well as taking full lecture notes.

My lecture notes are compiled from a score or so of text-books and periodicals, and are continually being re-written and brought up to date, and I only ask my students to buy two books, one for the lectures and one for the laboratory.

I guide the reading of the students by keeping all the books in the college which treat of electro-technology in my private room, and lend them out to the students to read marked portions, and thus supplement their own text-book and lecture notes.

Lecturer.

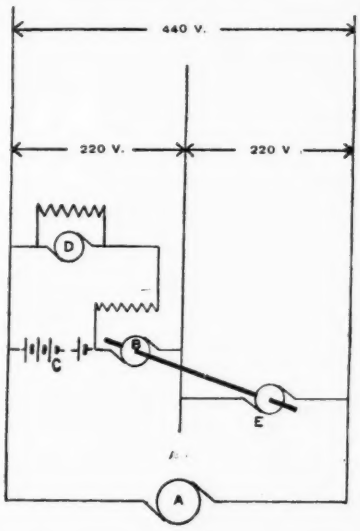
Batteries with Reversible Boosters.

The letter on this subject in your issue of the 27th ult. is of timely interest. A suction gas producer plant with a battery controlled by a reversible booster appears an ideal installation for a small town, but there are a number of points about working with reversible boosters that require explanation, *e.g.*—

1. Do reversible boosters permit of being left running by themselves all night on a comparatively light load without any attention ?

2. Can the battery be conveniently *discharged* if found necessary, without the booster working ?

3. Do complications arise if a combined balancing and charging booster set is installed ?



4. The charges and discharges being intermittent, is there any ready means of checking and comparing at stated intervals the amount of ampere-hours stored in the battery ?

5. For the purpose of keeping the capital expenditure low in a small three-wire installation, would it be feasible to work with a "half pressure" battery (C) and a reversible booster ?

6. Or, further, to couple directly with the charging booster (B) another machine (E) on the opposite side of the three-wire system, as is shown in the accompanying diagram ?

P. B. O.

[There are immense possibilities in the use of suction gas plants combined with batteries, and using overhead conductors, for the supply of small towns and villages. We may point out, however, that there is no necessity to adopt the three-wire system, with its inherent complication and expense, for the lighting of a small town.—Eds. E.R.]

Destructors and Electricity.

Owing partly to the publication of a very instructive paper, read by Mr. W. P. Adams before the Institution of Electrical Engineers, public interest in the above question has been considerably stimulated. I think, therefore, that it may not be out of place to point out, with your kind permission, some misconceptions which may arise.

There is a tendency in some quarters to estimate the efficiency of any particular destructor by the number of electrical units per ton of refuse, which are produced in the works where such destructor is in use.

The number of units produced per ton of refuse burnt depends chiefly on the following factors :—

1. The calorific value of the refuse.

2. The conditions as to day and night load, which determine whether all the refuse is used for steam raising, or whether the destructor is working at full power, while the electricity plant is practically idle.

3. The efficiency of the electrical generating plant, which may require more or less steam per unit generated.

4. The efficiency of the destructor plant with its boilers and flues.

5. Last, but not least, the efficiency of the management.

It is, therefore, absurd to attribute to the destructor, either the whole credit for a good result in units per ton, or the whole blame for a poor result, and this is demonstrated by the fact that you will find one destructor of a given make giving a very high figure, and another destructor of the same make, but under different conditions, giving a low figure.

One of the most important factors in the efficiency of a destructor, the cost of labour, is usually ignored when dealing with steam-raising results. In any destructor, increased steam-raising results can usually be obtained by putting on increased labour and "stoking in spoonfuls." From the steam-raising point of view, the all-important question is, What is the cost of a ton of steam produced by the destructor in ordinary everyday work? Under the heading "Steam from Refuse and its Cost," the *Electrical Magazine* published on April 26th, 1904, some interesting figures showing the cost of labour per ton of steam, as well as the evaporation per pound of refuse, at a number of combined stations. It was shown that those stations where the highest evaporative results are obtained are not always the most economical, owing to the large expenditure in labour, and it is noteworthy that among those stations where the utilisation of steam is complete, the best result came from Fulham.

If the destructor produces a supply of steam at a reasonable cost for labour, it is for the electrical department to utilise that steam, and the credit for good results and the blame for bad results belong by rights to the engineers who are responsible for the construction and management of the whole combined works, and not to the maker of any particular part of the installation. I think that if the above facts were more generally recognised, it would be in the interest alike of electrical engineers, destructor builders and the public, and would tend to discount a good deal of humbug.

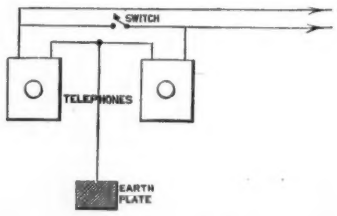
F. L. Watson, A.M.I.C.E.

Leeds, *January 31st*, 1905.

Telephones.

I have recently put up two telephone lines connecting a central office to two points about 1½ and 2 miles away respectively. At the central office I have a separate telephone instrument on each line with a switch to connect the two lines together, if necessary, and both instruments are connected to a common earth plate (see sketch).

Both telephones work well, except that a conversation on one line can be heard on the instruments of the other line when the switch is open.



Is this due to induction, and, if so, can any of your readers tell me the best way of overcoming this trouble? The line wires are run on poles with porcelain insulators, and for a good part of the distance both wires are on the same pole.

M. G.

[The result described is undoubtedly due to induction; this cannot be cured unless twisted metallic circuits are used. —Eds. E.R.]

Wireless Telegraphy and War Correspondence.

My attention has been drawn to certain statements in your issue of January 27th, under the heading of "Wireless Telegraphy and War Correspondence." Apparently the writer of the article had not seen my letter to the *Times* of January 21st, wherein I stated that the speed of working of Marconi instruments is the speed at which the fastest sound reader can take messages.

Capt. James intimated in his lecture, and in his reply on the discussion, that he had had an opportunity at the New York yacht races in the summer of 1903 of comparing the working of what is described as the De Forest system with that of other systems. He stated that both on the score of speed and tuning he found the De Forest system superior to other systems; he stated that the speed of all the other systems which he had investigated was only 10 or 12 words a minute, and that the speed of the De Forest was from 30 to 35 words a minute; and he gave what he considered evidence of his contention that, with the De Forest system, good tuning can be obtained.

As the reporting of the yacht races for the Associated Press was carried out by Marconi instruments, presumably the Marconi system is included in Capt. James's expression "other systems." I must point out, therefore, in the first place, that Capt. James had no opportunity of witnessing the working of the Marconi system at the yacht races in 1903; he had no means of ascertaining the speed at which we were working; and the only knowledge available of the results of the working was from the publication by the Associated Press of the news transmitted by us and sold to the Associated Press under our contract with them.

As long messages were transmitted and published, and as the Associated Press paid us for the news, it may be presumed that, from a commercial standpoint, our working at the yacht races was a success. Whatever the results, however, Capt. James had no means of judging of their value, except from the accounts published by the Associated Press of the races from messages transmitted by our system, and those accounts were themselves evidence of the successful working of the Marconi instruments.

Secondly, the speed of the Marconi system is not limited to 10 or 12 words a minute. Given practically unlimited speed of transmission—and with automatic working, the speed of transmission can be made very much more than the 30 to 35 words a minute spoken of by Capt. James—the working speed of the Marconi system is limited solely by the capacity of the operator at the receiving station to read by sound; and if anyone could produce a sound-reader capable of reading at 50 words a minute, we should have no difficulty in showing Marconi instruments working at that speed.

The only Marconi working which Capt. James has had an opportunity of witnessing, was with recording instruments. These work at a higher speed than the 10 to 12 words a minute which he mentioned, but in any case a comparison between recording and sound reading instruments is misleading. When we work with sound reading instruments, our speed is anything from 30 to 35 words a minute, and faster if an operator can be found who can read more rapidly.

Thirdly, what Capt. James regards as evidence that the De Forest instruments are immune from interference is, strictly speaking, no evidence at all. He began his paper by saying that he had no technical knowledge of wireless telegraphy, and to this fact must be attributed the conclusions at which he arrived as to the evidence of immunity from interference in the working of the De Forest instruments in the East.

Capt. James admitted that the De Forest instruments were interfered with when within a mile of other stations. This is not evidence of good tuning; nor is it proof of good tuning to assert that the De Forest instruments were unaffected when more than a mile from the other stations. In the first place, there is no evidence that the other stations were working when the De Forest instruments were unaffected; and, secondly, if the other stations had been working, absence of interference with De Forest instruments more than a mile away is not a result to boast about.

Mr. Marconi, in 1901, when he employed the words which you quote with regard to tuning, did not "prematurely adumbrate a possibility," but stated a fact—a fact which has been demonstrated commercially, not for a few days or weeks with an experimental installation under conditions which are not well ascertained, nor even defined by the person who purports to describe them, but for several

years in daily commercial working, under circumstances which admit of careful tests being made by independent persons.

Mr. Marconi's claims to success in syntony are based upon the evidence of independent experts, and tests have been made under circumstances which do not admit of the conclusion that the results obtained were due to causes other than tuning. With two instruments—not one mile apart, but within a few feet of one another—two distinct messages are simultaneously transmitted to two similar instruments at the receiving station, these instruments also being within a few feet of one another.

This test has been repeatedly made in the presence of Government experts, who, as may be gathered from the contracts quoted below, have been thoroughly satisfied with the results.

A further test, which by some people would be considered a more severe one, is a test which has also been carried out by independent experts. At Poldhu we have a very powerful station, capable of transmitting messages across the Atlantic. At the Lizard, 7 miles off, there is another station, used for the ordinary work of communication with ships at sea. Messages from this Lizard station can be received at a small station within a few yards of the Poldhu station while Poldhu is sending messages across the Atlantic.

The writer of your article states that he has no difficulty in understanding my objection to the character of the lecture, the suggestion being that the lecturer had clearly established the superiority of the De Forest system, both on the score of speed and tuning. Accepting Capt. James's statement with regard to the speed of the De Forest instruments, I deny emphatically that the speed of the Marconi instruments is limited to 10 or 12 words a minute; on the contrary, we can transmit as fast as anybody can read by sound, which is about 30 to 35 words a minute; and no one with even a rudimentary knowledge of wireless telegraphy would accept as evidence of good tuning the facts put before the Society of Arts by Capt. James at his lecture.

There are, however, large numbers of the uninstructed public—including, apparently, the chairman, Sir William Preece—who are readily misled by such statements; and although Capt. James began his lecture by stating that he had no technical knowledge of wireless telegraphy, it did seem to me pertinent to inquire to what part of the results obtained he attached importance.

His answer was, in effect, the speed and the tuning. The speed claimed is nothing more than can be achieved by anyone with sound-reading instruments; the evidence of tuning simply showed the bad result that within a mile of other stations the De Forest instruments were interfered with, and did not definitely show that outside a mile of other stations the De Forest instruments were free from interference.

The Marconi companies have at the present time contracts with the Admiralty, the Post Office, the Italian, Canadian, Belgian and Newfoundland Governments, and with Lloyd's. There are over 50 first class passenger ships on the Atlantic alone equipped with our apparatus, including German, French, American, Italian and English liners. We are, I believe, the only company working wireless telegraphy commercially, in the sense that we transmit the messages of the public on payment of a fixed rate. Our instruments have been working commercially for Press purposes, and for the transmission of the messages of the public, for several years, over distances 10 times those claimed by Capt. James for the De Forest instruments, in almost every latitude, from shore to shore over water, from ship to shore, from one point to another over land, for almost every conceivable purpose, not experimentally, but serving a need of the public, in some instances in substitution for cables: and yet, anyone has only to erect a wireless telegraph station which is a more or less good copy of instruments we regarded as obsolete four years ago, and to send messages over 50 or 60 miles, to receive considerable notice from the Press, and even from scientific societies.

We hear of German systems, yet the German liners are equipped with the Marconi system; we hear of French apparatus, and yet the French liners carry ours; we hear of Italian inventions other than the Marconi, and yet the Italian liners are fitted with the Marconi instruments; we hear of American systems (even of the De Forest), and yet the ships of the Trust, as well as the English, French, German, Dutch, Canadian and Italian vessels, all have our system. But still we are told that, while Marconi is occupying himself with dreams of trans-Atlantic telegraphy, other persons are applying their "new systems" to the "legitimate end of wireless telegraphy—ship to shore communication."

And although for several years we have carried on a very big wireless telegraph business which, without good tuning, would have been impracticable, Marconi still "adumbrates a possibility," and De Forest, with an experimental installation which cannot work within a mile of other stations, "has solved the great difficulty of syntony."

H. Cuthbert Hall,
Managing Director,
Marconi's Wireless Telegraph Co., Ltd.

London, E.C., *February 7th*, 1905.

Is Steel Conduit Wiring Doomed?

We have followed with interest the correspondence which has appeared in your columns regarding the above matter, and in reply to Mr. Moss's inquiry, would say that we are the sole British agents for the Bergmann Co., of Berlin, and can supply this tubing; in point of fact, it was introduced on the Continent many years ago by the Bergmann Co.

We are sending some samples of this tubing to you, Mr. Editor, as you have for a long time taken an interest in wiring questions, and particularly the question of interior conduit wiring, on which so much depends.

Adnil Electric Co.
F. G. Kretschmer, *Manager.*

London, *February 6th*, 1905.

[This correspondence is now closed.—Eds. E.R.]

A Bogus Inquirer.

If it be not already too late, may we warn other electricians against a gentleman giving the name of Dr. Bayliss, Holmewood, Folkestone, (an address which does not exist), and a reference to the London and County Bank (which has no branch at Folkestone). He is inquiring for an installation of electric light, and will patiently waste quite a lot of time in the process. At the end he discovers that he has not got enough money for his railway fare, and would fain borrow the deficiency. No one is likely to lend it to him, but the loss of time before he comes to the point is annoying.

W. A. S. Benson & Co. Ltd.

New Bond Street, W.,
February 7th, 1905.

Tabloid Electricity.

The suggestion of "Greenhorn," in your issue of the 20th ult., to "bring electricity round on a cart, and deliver it at the door, like the daily milk," was, I believe, tried about 20 years ago. I remember, when a student, in 1884, at the Hanover Square Electrical Engineering School, that the late Mr. Desmond Fitzgerald did attempt a system of this kind with his Lithanode battery. Probably, if some one who then worked with Mr. Fitzgerald could be discovered, he would be able to say to what extent the scheme was successful.

Frank Broadbent.

4, Queen Street Place, E.C.
February 7th, 1905.

Calcium Carbide as an Explosive.—A paper suggesting the employment of calcium carbide as an "explosive," or disruptive agent in mining, was read before the Académie des Sciences recently by M. P. S. Guédras. In his experiments the rock was drilled, and charges of 50 grammes, which generated 15 litres of acetylene, were used. The effect produced was a loosening of the rock, so that it could be easily broken up with pick or hammer. No projection of the broken masses took place. From his experiments, the author concludes that calcium carbide is an "explosive" which should be useful in warfare.

PARLIAMENTARY.

Hammersmith, City and North-East London Railway Bill.

This Bill, by which it is sought to construct a tube railway about 20 miles long, came before Mr. Campion, the examiner, on February 1st, for proof of compliance with standing orders. Several memorials had been deposited against the Bill.

Mr. Brown (Parliamentary agent) first alleged, on behalf of the opposition, that standing orders had not been complied with inasmuch as the plans deposited with the Chelsea Borough Council were not copies of the plans deposited at the Parliamentary offices.

The Town Clerk of Chelsea gave evidence to the effect that plans were deposited with him prior to November 30th, and on December 6th a Mr. Newell called and asked to insert certain numbers on the plans. He made no objection, but made a note of the proceedings. He did not oppose the Bill officially.

Mr. Kennedy, who appeared for the promoters, said his contention was that on November 30th the plans were the same. It was time that they were supplemented, but he withdrew the correction.

Mr. Brown submitted that it was a serious matter. The plans when deposited were the authority to the promoters to take certain lands. If the number on the plan was not shown in the book of reference, then the promoters would have no right to take the land. He confessed that he saw no difference between altering the deposited plans and altering the title deeds of the company. He contended that the plans deposited with the Town Clerk of Chelsea were not copies of those deposited in the Parliamentary offices on November 30th; and, further, that the book of reference was deficient, as it did not give the names of owners and occupiers in Chelsea. He ventured to suggest that the Examiner should not merely report a non-compliance, but that it was of serious importance that in some way it should be brought to the notice of the House. He had the Clerk of the Peace of the County of London who would show that similar alterations were made in the plans deposited with him, and in this case the plans had to be deposited in duplicate, and one copy was sealed. The result was, that the alterations were only made in the copy open for public inspection.

The Examiner said Mr. Brown was entitled to a non-compliance in respect of this matter.

Mr. Kennedy said it was perfectly competent for the promoters, if they discovered an error in the deposited plans, to deposit supplementary documents. In this case the referencer, having discovered an error, endeavoured to correct it in an inefficient way. He did nothing criminal, but he did not do it properly. He asked to withdraw the supplementary documents.

The Examiner said the objectors would be entitled to a non-compliance, and he should use words in his report setting out the circumstances, but he should not say that in his opinion there had been a misdemeanour.

Mr. Brown next alleged that the promoters had failed to comply with the Standing Orders, inasmuch as they had deposited the whole book of reference in Chelsea instead of a section. He urged that in the case of railway Bills it had been held that only sections of the reference should be deposited, so that owners of property could without difficulty find if they were affected.

The Examiner held that the promoters had deposited the section of plans and refused to sustain the allegation. He also struck out the allegation that the promoters had improperly described certain property in Westminster wrongly on the ground that the allegation was defective.

Mr. Campion continued his examination of the Bill on the 2nd and 3rd inst., and a great number of allegations were gone into, which in a few minor cases were sustained.

On 6th inst. the Examiner concluded his examination of the Bill. The promoters admitted that they had failed to deposit with the Paymaster-General the sum of money required under the Standing Orders, and on this the Examiner will also report a non-compliance.

The Bill will now go before the Standing Orders Committee, who will decide whether it shall be allowed to proceed.

Great Northern, Piccadilly and Brompton Railway (No. 2 Bill).—This Bill came before Mr. Campion, the Examiner, for proof of compliance with Standing Orders, on Monday. Memorials alleging non-compliance had been deposited by the Marquis of Salisbury and Sir Walter Phillimore, but an arrangement having been come to between the parties, there was no opposition, and the Bill will therefore go forward for first reading.

Metropolitan Water Board and Private Bills.—The Metropolitan Water Board has decided to petition against the following Bills unless the promoters agree to insert clauses for the necessary and proper protection of the Board's mains, pipes, and general distribution works:—London Southern Tramways Co., Ltd.; Metropolitan Electric Tramways; Great Northern, Piccadilly and Brompton Railway, No. 2; Charing Cross, Euston and Hampstead Railway; Hammersmith, City and North-East London Railway; Baker Street and Waterloo Railway; North-East London Railway; Croydon Corporation; Metropolitan Pneumatic Dispatch Co.; Administrative County of London and District Electric Power Co.; East London and Lower Thames Electric Power Co.; County of London Electric Supply Co., Ltd.; Metropolitan Electric Supply Co., Ltd. (Acton District).

LEGAL.

Phillips *v.* Kingston, Miller & Co.

Mr. Justice Ridley sitting, with a special jury, in the King's Bench Division on Monday, and the two following days, heard an action by Mr. Lionel Phillips against Messrs. Kingston, Miller and Co., contractors, of Oxford Street, for damages for alleged negligence. Plaintiff contracted with the defendants to erect for him a temporary supper room at the back of his house in Grosvenor Square in July, 1903, when he was giving an entertainment, for which Madame Melba and other artists had been engaged. On the night of the entertainment the room was burnt down, in consequence, as plaintiff alleged, of defendants' negligence.

Sir Edward Clarke, K.C., Mr. Bankes, K.C., and Mr. Graham appeared for the plaintiff, and Mr. Dickens, K.C., and Mr. G. Wallace for the defendants.

Sir E. Clarke said the supper room was erected on the leads covering the lower part of the premises. The defendants handed over the construction of the room itself to Messrs. Simmons and Sons. All they did themselves was to supply chairs, silver, glasses and other materials for the supper. The supper room was a wooden structure, covered and lined with canvas and hung with art muslin, and lit by electricity. It was a most fortunate thing that the fire occurred when it did. Had it taken place later, there would probably have been a most appalling disaster. Just before half-past eight the lights were turned on for Mrs. Phillips to see the effect. She went back at once into the house for dinner, but before she got to the dining-room there was an alarm of fire, and in 10 minutes the structure was destroyed, and the house itself was only saved with difficulty. The workmen had to fly for their lives, and were unable to save their hats and coats.

The evidence of Mr. and Mrs. Phillips and Mr. Miller, manager of the defendant firm, taken by deposition, was read. The latter stated that he knew nothing about electricity, and could say nothing about the lighting, which was entrusted to Messrs. Simmons.

Mr. T. J. Rorke, of Rorke Bros., electrical engineers, Jermyn Street, said he had made an inspection after the fire. He found that there had been 155 lamps, of which 18 were full-sized electric lamps, and there were four electric fans. There were altogether eight double-pole safety fuses—19 8-c.p. lamps to each pair of fuses. The fact that there were a large number of lamps upon one circuit increased the risk of fire. A recognised allowance was 10 lamps to each circuit, and this should not have been exceeded. From samples which he took away he found that there were four conductors, each containing 70 strands, brought into each miniature lampholder. In employing the looping system in such circumstances great care was necessary, as if one or more wires were left loose, the holders being so small and the openings so close together, a short circuit was almost sure to be set up. In short, the system employed gave 137 points of danger. The risk would have been enormously reduced by wiring the lamps two or three in series, and there would have been no difficulty in doing that. He should never have sanctioned an arrangement of hanging 200-volt lamps among muslin.

Cross-examined: The looping system was not dangerous in itself, but became so when miniature lampholders were used. If the lamps had been 5-c.p., it would have been improper to have a circuit of 20 lamps at a voltage of 200 and a current of 2 amperes with two fuses, one in each wire, because the amount of wire and the loose ends in the lampholder had to be considered as well. If there had been 10 lamps, the fuse could have been smaller, and would have gone with more certainty.

Further cross-examined, Witness said the looping system was adopted to save time. In any lamp, whether used in the tree or the looping system, there must be points of danger because the wires must be bare where they went into the porcelain. There would be the same danger in a lamp with two wires instead of four, but to a less extent. The result of a short-circuit would be a flash and a miniature explosion, and the fuse would go, usually instantaneously, but not always.

If you took care to take the insulated wire inside the lead, as we did, there could be no flash outside the cover. Having regard to the fact that our wires were protected in this way, is the looping system more dangerous than the tree?—The looping system used in a modified manner with large lampholders is not dangerous.

Supposing the distribution of the lamps does not increase the amount of current beyond the normal, how does it matter how you distribute the current?—From the point of view of the fuse going it does not matter.

Why do you want more than one fuse at each pole?—Because you can then use a much thinner wire, and that makes the system safer. When the fuse goes the fault that has caused it to go may at the same time cause a fire.

Not if it is in the holder?—Yes, it will.

The risk is the same in every system. Do you agree with that?—Not in such a structure as this, when one must have had the fuse wires thinner.

The rules of the Institution of Electrical Engineers say that you can have three amperes, and so long as you do not exceed that, all you require is a fuse on each pole. I point to the rules of the company supplying the place with electric light.

Do you disagree with the rules of the Institution?—When lamps are used among drapery, yes, I do. The rules were never drawn up for temporary lighting. Witness added that his theory was that there was a flash in one of the lampholders which communicated with the muslin, or it might have run back on the silk covering of the wires.

Re-examined: In each installation, if everything was done perfectly, there was no fire. Fire occurred when something was done imperfectly. Some systems increased the risk of danger, because of the possibility of something being done imperfectly. The system adopted in this case was one in which the risks were great, and the large number and small size of the lamps increased the risk.

Col. Crompton, C.B., R.E., M.I.C.E., &c., said he had also made an examination after the fire. He should say that the fuses, though sufficient for a safe system, would be a source of danger, and would not protect the system employed in this case. Fuses were no protection in the case of a short circuit, which occurred when two very small wires—No. 40's in this case—formed a bridge or short circuit across the terminals of the lamp. He had, himself, prepared an installation similar to one of the circuits used in the present case. He had wired it as carefully as possible, but immediately he switched on a current of 200 volts, there was an explosion in one lamp, and it set light to a piece of cotton wool 2 in. away. He put in a new lamp and switched on again, when another lamp went in the same way. He repeated this a third time with the same result. The cause was that it was a moral impossibility to twist together 140 No. 40 wires, and push them into the small hole in the socket without leaving one or two behind. A slight movement or oscillation of the lamp brought the loose ends into contact, and caused an explosion. It was not possible to ensure safety in using this system with small lamps. It introduced a maximum of risk. In his model installation, in no case did the fuse go, though he used a 7-ampere fuse. The fact of the point of danger being under the cap was an additional objection. When there was drapery near incandescent lamps, great additional precautions must be taken, and the possibility of a flash of any description must be diminished as much as possible It was for that reason, that he was so strongly of opinion that the looping system should not be allowed in a case of this kind. The cap would afford no protection. It acted as a gun, projecting the flash in one direction, and rather further than if there was no cap.

Cross-examined: He had never heard of the looping system being used with very small lamps.

Do you suggest that it would be gross ignorance in an electrician of experience if he said the looping system could be safely used?—Yes. It should only be allowed, if at all, where there was no risk of danger in the case of a flash. The looping system used in connection with small lamps was not contemplated when the rules of the I.E.E. were drawn up. It was only introduced as a slipshod practice of wiremen two or three years ago.

A circuit was here handed up in which calico was twisted round the conductors.

The Witness: This is very interesting. I did not know it had calico twisted round the whole length. That is what caught fire. You have given me information which I was unaware of before. If that resembles exactly, the circuit put up, I have an additional reason for saying it was diabolically dangerous.

Would not the fault, if any, have shown itself during the previous tests?—No, it does not follow at all. It is entirely a matter of chance when the lamp goes. Tests are useless.

Re-examined: He did not think any fire insurance inspector would have passed this arrangement.

Expert evidence was also given by Mr. Jas Swinburne, M.I.E.E.

For the defence, evidence was given by Samuel Waites, foreman in the employment of Messrs. Simmons Bros., who said the whole of the fittings were put together and tested in the shop for half-an-hour. There were six circuits of 20 5-c.p. lamps in the room, and there were in addition some eight on the staircase. There were in all 18 single-pole fuses. Witness went into the room with three assistants after the lights had been turned on. One of the men said, "I smell something burning. Switch off." Witness immediately switched off, and looking up saw a black patch, the size of the palm of his hands on the muslin. He had previously noticed that smoke was coming from the direction of the electric fan which was working at the time. The man beat on the muslin with his hands, and it at once burst into flame.

Cross-examined: There would probably have been no flame if Brown had not beaten upon the muslin. Simmons Bros. carried on business at Newton Street, High Holborn. He denied that plaintiff's butler pointed out to him that there was a danger of fire, and that he replied that there was none, and further that if set alight the muslin would not blaze. He was, however, of opinion that it would not blaze. He had never seen muslin ablaze before. Until he saw it ablaze he was convinced that it would not blaze.

Re-examined: He had to enter and leave the premises by way of the harness-room, and he remembered seeing a fire in the harness-room at tea-time. He could not say where the smoke came from that was drawn into the room by the fan.

(To be continued.)

[The remainder of our report will appear next week. On Wednesday the jury returned a verdict for the defendants on both the claim and the counterclaim. Judgement was entered accordingly.]

O'Connor *v.* Thompson & Co.

On the 2nd inst., at Manchester Assizes, before Mr Justice Walton, the case of O'Connor *v.* Thompson & Co. was heard. The plaintiff, a labourer employed by the British Westinghouse Electric and Manufacturing Co., Ltd., was engaged in loading scrap iron, supplied by the defendants, into a cupola, when an explosion occurred, plaintiff as a result losing the sight of his right eye and injuring that of his left.

It was asserted by plaintiff that an unexploded cartridge such as was used for breaking up scrap iron, had been left in a piece.

Eventually the jury disagreed and were discharged.

The Manchester Corporation and Vibration.

The Manchester Corporation appeared as defendants in an action in the Lancashire Chancery Court at Manchester, on January 30th, before Vice-Chancellor Sir S. Hall, K.C. Mr. Barlow, the plaintiff, sought to restrain the Corporation from committing a nuisance to his property by vibration from the Dickinson Street electricity works.

During the hearing, it was stated that the action first came on in February, 1903. The Corporation had since that time experimented at considerable expense with the generating plant in the station, with a view to remedying the vibration trouble, but without success. They had since decided to substitute two steam turbines for certain other plant, but the contract had not yet been completed. The present application was that the trial of the action should be fixed for a date earlier than March 28th.

After considerable argument, the Vice-Chancellor said that plaintiff must have a reasonable time in which to observe the effect of the alterations now being made, and it was ultimately agreed that the trial should stand over till the first Tuesday in 1906, the existing undertakings to be continued in the meantime.

Action against Tramway Contractors.

At the Coventry County Court on the 7th inst., Alfred Fretton, of Coventry, sued Messrs. Robt. W. Blackwell & Co, contractors for the Coventry Tramways Co.'s extensions in that city, for damages for personal injuries received while motoring along a portion of the road under reconstruction.

The evidence as to the lighting of the roads was very conflicting, and after a lengthy hearing the jury found for the plaintiff, damages being assessed at £10. Judgement was entered accordingly.

Cab Accident Claims in Manchester.

At the Assizes now being held three cases have been tried, in which damages have been awarded for personal injuries arising out of tramcar accidents. The first was a case in which George Cross, a cab proprietor, was the plaintiff. On August 18th last he drove a bank official from Victoria Station, with three boxes of bullion, to the Manchester and County Bank in King Street. In Cross Street the cab was run into by a disabled bogie car, which was on its way to the depôt at Cheetham Hill, and which got out of control in descending the slight incline near the junction of Cross Street with Albert Square. The car was not coupled up with a second car, which was pushing it forward, and the brake could not be applied because the handle was entangled with the trolley rope. The Corporation admitted negligence, and the jury awarded the plaintiff £500.

In another case also negligence was admitted, and a Sheriff's Jury was empanelled to assess the damages. The plaintiff was a married woman, named Wiggins, who claimed compensation for injuries sustained in a collision between two cars in Bury New Road. The accident happened on July 27th last, and arose through one of the cars not entering a loop in sufficient time to allow the other to pass. They collided and became interlocked. Both were heavily laden with passengers. The plaintiff was severely injured. The jury gave her £400.

In the third case the Corporation did not figure as defendants, although an electric car was concerned in the accident. On May 16th last, one of the Palatine Road large bogie cars was turning out of Mosley Street into St. Peter's Square, when a lurry belonging to the London and North-Western Railway Co. collided with it. The collision was of the slightest possible description, but its indirect consequences were most serious. The traffic at that point was very much congested at the time. The lurry driver, when the impact took place, backed his horse, causing the lurry to back into a Great Northern Railway parcels van, which, in its turn, backed into a heavy lurry belonging to a firm of bleachers and dyers. Between the two last-named vehicles a young woman and a boy were caught. The boy was killed, and the woman—Miss Florence Taylor—received terrible injuries, including a compound fracture of the left leg and a broken jaw. She sued the London and North-Western Railway Co. for damages. The company endeavoured to prove that the blame rested with the driver of the electric car, and not with their lurryman. The jury, however, found for the plaintiff against the railway company, and awarded her £679. Judgement was withheld pending the settlement of some points of law.

Furlonger *v.* London Electric Supply Corporation, Ltd.

In the King's Bench Division of the High Court of Justice on Tuesday, before Mr. Justice Darling and a special jury, the case of Furlonger *v.* The London Electric Supply Corporation, Ltd., which was an action arising out of a fatal accident at the defendants' works, came on for hearing. Mr. Germaine, K.C., and Mr. Cairns were counsel for plaintiff; and Mr. Pickford, K.C., and Mr. Bailhache appeared for the defendant company.

Mr. Germaine said the action was brought under the Workmen's Compensation Act, and the plaintiff was the father of a youth who met his death in the defendants' works. The defendant company had in Blackfriars Road a sub-station, where the youth was employed as a cleaner. The sub-station was connected with the main station at Deptford, and it had the usual appliances for converting the high-pressure current which entered it at 10,000 volts to

2,000 volts, and then conveying it to places where it was used. Such a current was, of course, sufficient to cause death to anyone coming in contact with it, and the greatest care was necessary to protect the people employed in the place from injury. There were a number of converters which the young man had to clean and dust every morning, and on March 4th last year, whilst he was so employed, he fell down and caught hold of a live wire. He was picked up insensible, and taken to a hospital, where it was found necessary to amputate one arm and two legs." He died, and his parents now brought the action to recover damages on account of the alleged negligence of the defendants in not efficiently protecting the live wire. The father, the present plaintiff, applied to the company for compensation, and they offered to pay reasonable funeral expenses and medical attendance, if any, and compensation under the Workmen's Compensation Act, if they were satisfied that he had left anyone dependent upon his earnings. Plaintiff's solicitor asked for £500 compensation, which he said he considered very moderate, but no settlement having been arrived at, the present action was brought.

The Plaintiff, Maurice Furlonger, and his wife, were called, and said their son's wages were 9s. per week, out of which he paid them 8s. weekly for his board.

Plaintiff, in answer to his Lordship, admitted that he had claimed £500 damages on the advice of his solicitor, who said that that was a moderate amount. He did not think the offer to pay funeral expenses, &c., was sufficient.

Mr. Germaine said that, under the circumstances, it was impossible to prove damage, and he could not carry the case any further.

His Lordship expressed the opinion that plaintiff had been very ill-advised to bring the action, as he was unable to prove either negligence or special damage; the deceased was only bringing into the house 8s. per week, out of which no profit could be made. Plaintiff's solicitor should have known better than to say that he considered £500 a moderate claim under the circumstances. If plaintiff would take his advice, he would see what he could arrange with the defendant company.

Mr. Germaine agreed, and the case was withdrawn on this understanding.

Action against the Postmaster-General regarding Underground Telegraph Cables.

An important point was raised in Hamilton Sheriff Court, on Thursday, the 2nd inst., in regard to the power of the Postmaster-General. A petition was presented to the Court by the District Committee of the Middle Ward (Lanarkshire County Council) seeking to interdict the Postmaster-General and the Lord Advocate from laying telegraph cables in the highway at Uddingston and Bothwell. Petitioners complained that, in contravention of the permission granted them in connection with the laying of the underground telegraph cables between London and Glasgow, the respondents were laying the cables too near their water pipes. Mr. Pitman, advocate for respondents, opposed the granting of an interim interdict, holding that the Sheriff Court had no jurisdiction over the Crown. After discussion, respondents agreed to lodge answers in the usual way, an undertaking being given that nothing further in connection with the laying of the cables would be done for a fortnight.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"Old Subscriber" writes:—"Will you kindly inform me in this week's Review whether a private generating plant, consisting of steam engine, dynamo, battery, and motor for pumping, comes under the Factory and Workshops Act? If so, will you please let me know all particulars, and what to do to comply with the same."

*** By the Factory Act, 1901, it is provided that the expression non-textile factory includes "electrical stations," that is to say, "any premises, or that part of any premises, in which electrical energy is generated or transformed for the purpose of supply by way of trade, or for the lighting of any street, public place or public building, or of any hotel, or of any railway, mine or other industrial undertaking" (S. 149 and Sched. VI., Pt. I., Sec. 20). Non-textile factories are, of course, subject to the provisions of the Act, but it is exceedingly difficult to say whether the plant used by "Old Subscriber" is really a non-textile factory within the meaning of the above section. It seems that the section is really directed to the inclusion of premises where electricity is generated for lighting purposes, *i.e.*, for the purpose of supplying electricity to consumers for a price to be paid by them. It does not appear to apply to the case of a man who generates electricity for his own purposes on his own premises, unless, indeed, his works come within the meaning of the expression "industrial undertaking." From the facts which "Old Subscriber" states, however, it does not appear that he has any intention of supplying electricity to other persons. If this be the case, it is conceived that he will not be the owner or occupier of a factory within the meaning of the Act of 1901. Having regard to the view thus expressed, there is no occasion to specify the duties and obligations of the owner or occupier of a factory.

BUSINESS NOTES.

Machine Tool Accessories. — Messrs. Edward G. Herbert, Ltd., engineers, of Rosamund Street East, Manchester, have sent us particulars of their Vee cramps and blocks and box jigs. The former device, see fig. 1, offers a secure method of correctly fixing shafting, &c., for the purpose of cutting keyways without interfering with the holding-down bolts at every setting. No loose plates and packings are required, and the shaft rests on a horizontal planed surface, so that its parallelism is ensured. The Vee blocks are made of good quality cast-iron, and are accurately machined

Fig. 1.

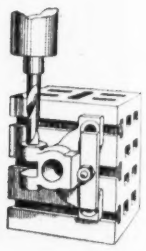


Fig. 2.

and scraped. The box jigs (fig. 2) form an exceedingly handy attachment for machine tool work, it being possible by their use to drill or machine at one setting of the work, any surface parallel to the several sides of the jig, which is, of course, accurately machined and squared. The latter device will frequently save the making of special jigs.

Electric Fittings Show-Rooms. — We have already made certain references to the new electric light fitting and heating show-rooms which have been fitted up by Messrs. Falk, Stadelmann and Co., Ltd., at 83—87, Farringdon Road, E.C. Last Friday, together with a number of others interested in such matters, we had an opportunity of having a look round the premises for ourselves, and we were certainly most favourably impressed with the very excellent and artistic display of electric light fittings made in various attractive styles. There are many well-arranged show cases, and the effects produced by proper attention to silk and glass shading were seen to the best advantage. An exhibit of electric cooking and heating appliances, whose chief characteristic is that they are easily repairable if necessary, was on view. Messrs. Falk, Stadelmann have recently taken over this section from another firm, as already announced. A large assortment of telephonic apparatus was also on exhibition. There is no need for us to enlarge further, as we have already described a number of the designs of fittings which are on show, but we think that consulting engineers and installation firms should bear in mind that these show-rooms—which are quite as effective as any of the kind that we have seen—are open for their own and their clients' inspection at any time, and that much has been done on these premises to aid the customer in choosing the particular fitting that he requires for particular surroundings.

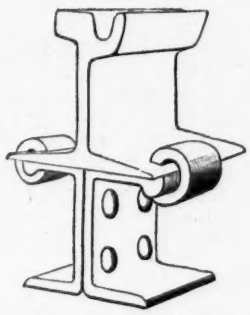
Lamp Tests.—We have received the following letter on this subject:—"Dear Sir,—Referring to the notice which appears in this week's paper in connection with the independent tests just concluded by the Westminster Electrical Testing Laboratory, of York Street, Westminster, we would ask you to be good enough to mention that the A.E.G. make (Electrical Co., Ltd.), which is a foreign one, comes out almost as well as the best English make, and infinitely better than the average make of the various manufacturers. Therefore, taking into account that the price of our lamp is very little above half the price of the best English make, it is evident that the advantages are to be claimed for the former, as consumers can better afford to replace the lamps, considering the cost of the same.—Yours faithfully, The Electrical Co., Ltd., Lamp Department."

Paterson Purifiers for Power Plants.—Among the orders recently executed and received by the Paterson Engineering Co., Ltd., for their feed-water purifiers are the following:—Messrs. Babcock & Wilcox, Ltd., for H.M. Dockyards; Pembroke, and Gosport and Fareham Tramways; Messrs. Belliss and Morcom, Ltd., for their Ledsam Street Works; Messrs. Danks and Co., for H.M. Dockyards, Chatham; The Electric Construction Co. (2) for H.M. Dockyards, Gibraltar; The Mirrlees Watson Co., for Partick Electricity Works; Messrs. Crompton & Co., for Ultadunga Station, Calcutta; The Earl of Rosslyn's Collieries Co., Ltd.; Messrs. Sharp & Sons, Baltic Saw Mills, Dartford; Messrs. Busbridge & Co., Paper-makers, Kent; and other private firms.

The London Building Acts.—On Monday there was held in London a conference of representatives of the City Corporation and the Metropolitan Borough Councils, at which resolutions antagonistic to the London Building Acts (Amendment) Bill of the London County Council, and advocating the reference of the whole subject to a Royal Commission, were passed.

Bankruptcy Proceedings.—A first and final dividend of 3s. 6d. in the £ is payable on February 14th in *re* B. G. Hodges, electrical engineer, Derby (D. Sibbald, 23, St. James's Street, Derby, trustee).

The "Positive" Rail Anchor.—This is an attachment which has been patented by Messrs. Walker & Grant, and is intended to meet the demand for a simple anchor attachment for tramway rails. It will be seen from our illustration that the anchor is built up of "I" section, with bulbs along the edges of the top flanges. It is securely fastened to the rail by means of heavy clips driven on in a direction parallel to the rail. The device, which can be made of any size, obviates any drilling of the rails, and is so simply attached that its application to existing tracks should be a comparatively small matter. It has the further recommendation that it is cheap. Messrs. Naylor Bros., Ltd., of Golborne Ironworks, Golborne, Lancashire, are the makers.



"Positive" Rail Anchor.

Dissolutions and Liquidations.—A petition for winding up Messrs. Bryan, Donkin & Clench, Ltd., presented by Messrs. John Cameron, Ltd., is to be heard on Tuesday, February 14th, in London.

Messrs. T. A. Rose, L. E. Allen, and F. H. Sengler (Rose Electric Lamp Co., 56-57, Aldermanbury, E.C.), have dissolved partnership. Mr. Allen will attend to debts.

A meeting of the British Electric Works, Ltd., is to be held at 5, Fenwick Street, Liverpool, on March 9th, to hear an account of the winding-up from the liquidators, Messrs. H. E. Abbott and W. C. Spencer.

Messrs. E. Frowine and H. Resell (New Electric Novelties Co., dealers in electrical goods, 20, Paper Street, E.C.), have dissolved partnership. Mr. Frowine will attend to debts.

Messrs. J. B. and F. Rowcliffe (Atlas Engineering Co., engineers and tool makers, Levenshulme, near Manchester), have dissolved partnership, "as from October 19th, 1898," says the *London Gazette*.

Single-Phase Motors at Burton.—The Electricity and Tramways Department has lately had a large number of applications for motors, and Mr. P. J. Pringle, borough electrical engineer and tramways manager, has sent us particulars of some of them. The more important are as follows:—

Timber Mill.—Motors of 71 H.P. are being installed, these taking the place of an existing steam-driven plant. The motors consist of two 30 H.P. Siemens-Schuckert, one 10-H.P. and one 1-H.P. Fuller-Wenstrom. They are used for driving circular saws, planing machines, &c.

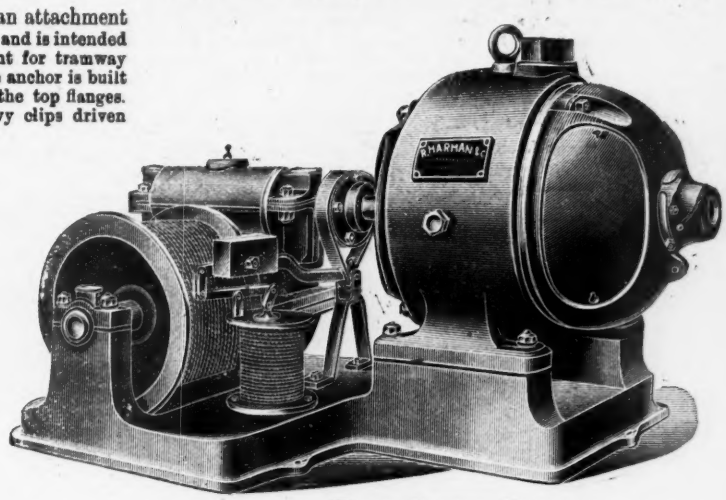
Large Stores.—A 4-H.P. Langdon-Davies motor for driving a hoist has lately been installed, and the economy of this is such that the owners will extend the installation to some 25 H.P. altogether, the motors driving two hoists, a passenger lift, bread and cake-making machines and cooling fans.

Butcher's Premises.—A 7½-H.P. motor has been installed for driving refrigerating compressing plant.

Contractor's Works.—In a building workshop a 5-H.P. motor has been put down for driving a circular saw, and a 7½-H.P. motor for a mortar mill. There will probably be added a further 5-H.P. motor for driving a planing machine.

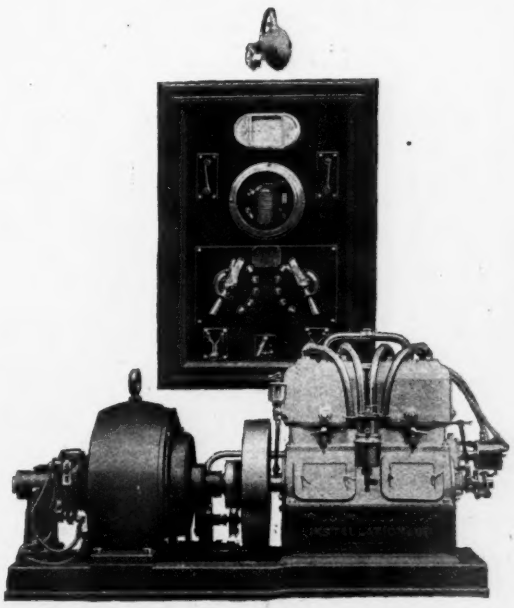
The total horse-power connected, with the applications in hand, amounts to 271 H.P. The electrical exhibition held last summer has done a great deal towards bringing about the large increase in the applications. The connections in motors 15 months ago only amounted to 60 H.P. The total equivalent in 8-C.P. lamps, motors, &c., connected, with the applications in hand, shows an increase in the past 12 months of 35 per cent. Mr. Pringle is to be congratulated on this remarkably rapid increase in the connections. Burton is a busy industrial town, and when the economy and convenience of electric driving are fully realised by the brewers and other large employers, there should be a splendid prospect before the electricity department.

The Harman Electric Hoist.—This hoist has been designed to meet the requirements of builders and contractors, &c.; it is light and portable, and at present is made in two sizes, to lift 8 cwt. and 20 cwt., at speeds of 80 ft. and 100 ft. per minute respectively. The smaller size is fitted with a 3-B.H.P. motor coupled direct to the worm gearing, which runs in an oil bath, the whole being compactly arranged on a cast-iron base. The second size is fitted with a 10-B.H.P. motor. The gearing is all machine cut, and the worm shaft is fitted with ball thrust bearings, to reduce friction to a minimum. For control purposes the makers supply a simple form of liquid controller. An automatic magnetic brake is fitted to the hoist, acting upon the coupling between the motor and gearing, and apart from the brake, these hoists are absolutely self-sustaining, thereby greatly reducing the risk of accidents. This hoist has many advantages over the friction hoist which has hitherto been very largely used in the building trade, among these being the fact that the motor is only running while the hoist is actually at work. We understand from the makers, Messrs. R. Harman and Co., of 10, Westmoreland Buildings, Aldersgate Street, E.C., that this speciality is meeting with considerable success among users.



Harman Electric Hoist.

Country House Lighting.—We have on previous occasions published particulars of self-contained electric lighting plants for country houses, as made on the Continent. We now have pleasure in describing a system devised by Mr. A. E. Farrow, chief engineer of the Windsor Electrical Installation Co., who has designed and put down a large number of such plants. The accompanying illustration shows the arrangement of the plant for a capacity of 70 lights, consisting of a high-speed petrol or oil engine, such as is used in motor-cars, directly coupled to a dynamo, occupying a floor space of only 5 ft. × 2 ft. 6 in. That is, the high-speed



Petrol Dynamo and Switchboard for Country House Lighting.

plant takes up less than a twentieth of the space that the old-fashioned plant of the same output would occupy. Moreover, the cost of the new style is only about half that of the old. The lights are perfectly steady, even if running without a battery, and as the engine is always ready to start at a moment's notice, the battery capacity can be halved, thus effecting a further saving both in floor space and capital cost. A further advantage is the obvious facility for charging the batteries of electric automobiles. The plant can be put down in almost any odd corner, instead of having, as is very often the case at present, a special building set apart for its sole use. The plant is designed from patents held by the Windsor Motor-Car Syndicate, and the Windsor Electric Installation Co. are prepared to carry out the complete lighting of country houses on their system. The cost per unit of electricity is very low, and arrangements can be made to install and maintain a plant at a fixed price per annum.

"Igranic" Rheostats.—The Sturtevant Engineering Co., Ltd., of 147, Queen Victoria Street, E.C., have recently added a number of improvements to their single and double automatic motor-starting rheostats, and are now placing on the market their

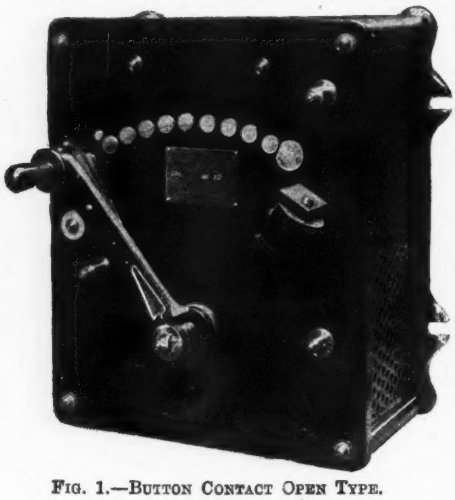


Fig. 1.—Button Contact Open Type.

latest designs under the name of the "Igranic" starting rheostats. The conditions which control the design of a first-class starting rheostat have altered during the past two or three years, mainly because corporations and supply companies have been raising the voltages for power supply, and it is to meet these that the improved type has been produced. The "Igranic" starting rheostat consists of a black enamelled slate front having the contacts, between which the sections of resistance are connected, mounted upon it, and a cast-iron ventilated resistance box. The contacts are of two sorts:—(1) The button contact, which is used for currents not exceeding 55 amperes; and (2) the renewable contact, which is segmental in shape, used for currents exceeding 55 amperes. All switches down to the smallest size can be fitted with these renewable segments, if required. The rheostat fronts are

Fig. 2—Semi-Enclosed Type.

made in two patterns, one fitted with automatic no-volt release, which allows the contact arm to return to the off position, in case of failure of supply; and the other fitted with automatic no-voltage release and overload cut-out, the overload coming into action when the current exceeds a predetermined amount. The front is provided with suitable terminals for taking the main cables, and a terminal is also provided for taking the connection from the shunt, in the case of shunt-wound machines, to the no-voltage release coil.

The principal feature in connection with the "Igranic" starting rheostat is the arrangement of the resistance box. The slate front described above is screwed to a cast-iron box and insulated therefrom by means of insulating washers and bushes. The resistance material is wound upon asbestos tubes, the latter being supported by specially formed porcelain insulators. This method of construction has proved by long experience to be most satisfactory, and provides a non-combustible, well-ventilated, highly-insulated resistance. The insulators are held in specially arranged perforated supporting strips, thus ensuring a very high insulation between the resistance material and the metal box.

The connections between the contacts on the slate front and the sections of resistance are made by means of specially formed clips, the connections all being made in chambers at either end of the resistance box. This arrangement has the advantages that there are no internal connections in the resistance box, and every joint can be inspected at a moment's notice.

The top, bottom and sides of the cast-iron resistance box are covered by perforated sheet metal, held in position by spring clips at the corners. It is, therefore, possible to open up and inspect the resistance box without removing a single screw, and without requiring any special tools. The "Igranic" starting rheostats are manufactured throughout at the Sturtevant Engineering Co.'s London factories, with first-class materials and workmanship, and can be supplied in three patterns:—The open type, illustrated herewith; the semi-enclosed pattern, also illustrated, provided with a metal cover to protect the operator against contact with any live parts; and the totally-enclosed pattern, which is suitable for positions where dust, &c., would interfere with the working of the rheostat. They can be supplied suitable for series, shunt or compound-wound motors.

New American Electric Motor-Cars.—Our New York correspondent writes:—"At the New York Automobile Show, held on January 14th—21st, electric vehicles were much in evidence, and in sufficient variety of size and price to suit every possible need, from the two-passenger runabout at £170 to the eight-passenger private omnibus at £1,200, and from the light delivery cart at £250 to the five-ton wagon selling at £850. The tendency in pleasure vehicles is towards graceful design and luxurious accessories, and in commercial vehicles towards simplicity. Electric pleasure cars are now fitted with incandescent lamps inside and out, electric signals between the occupant and the driver, electric cigar lighters, electric heaters and electric fans. The feature of commercial vehicles is that the batteries, motors, gearing and wiring are all placed beneath the frame. A typical wagon supplied to the New York Edison Co. has a load capacity of 2½ tons, a speed of 8 miles an hour, and a radius of 35 miles on a single charge. It has two direct geared motors and a battery of 42 Exide cells of 15 plates. A lighter vehicle ordered by the Philadelphia Electric Co., has a capacity of 1 ton, a speed of 11 miles an hour and a similar motor and battery outfit. One manufacturer has sold recently nearly 200 electric carts and wagons in New York City, one large department store having bought 17 cars, and hundreds of others have gone to all the important cities in the States. A £200 runabout on exhibition, weighing 6 cwt., carried two passengers 15 miles an hour for 40 miles, with a 12-cell battery. An old-established carriage firm has gone largely into the manufacture of electric cars, and claims for average street conditions, which are very bad in most American cities as compared with England, an average cruising radius of from 30 to 50 miles."

Electrical Trades Union Meeting.—The Electrical Trades Union held a public meeting at the White Hart Hotel, Acton, on Thursday, the 2nd inst. Among those who took part in the proceedings were Mr. James Macdonald, secretary of the London Trades Council, Mr. A. Ewer and Mr. J. Pearce, general secretary and president respectively of the Electrical Trades Union. A resolution was moved condemning the employment of cheap labour upon the electrification of the London railways, and it was stated that meetings were being arranged in support of the movement in various parts of London.

Cape Town Industrial Exhibition.—The *Times* announces that it has been decided to close the Cape Town Industrial Exhibition on February 28th.

Trade Announcements.—Messrs. John M. Henderson and Co. have established an office at 26, Victoria Street, S.W. Messrs. Henderson, whose works are at Aberdeen, are specialists in cable-ways, hoisting and conveying devices, cranes, rock drills, &c.

Messrs. Whittaker Bros., Ltd., of Dudley, have opened a branch office at 50B, New Street, Birmingham, owing to extension of business in that direction. They ask manufacturing houses to send catalogues and terms to that address.

Messrs. C. S. Rolls & Co., the well-known motor-car builders, of Lillie Hall, West Brompton, have transferred their head offices and showrooms to 14 & 15, Conduit Street, W., to which address all future communications should be sent.

Catalogues, Lists, &c.—Price lists have come to hand from Messrs. Ferranti, Ltd., Hollinwood, Lancs., relating to alternating-current ammeters and current transformers. The former are of the induction pattern, the only moving part being a small aluminium disk; there are no brushes or moving contacts. For sizes above 100 amperes, current transformers, as described in the latter list, are used in conjunction with a 10-ampere instrument. The company are prepared to make these in any size up to 6,000 amperes, suitable for any voltage up to 15,000.

The May-Oatway Fire Appliances, Ltd., 92-4, Paul Street, Finsbury, E.C., have sent us a nicely got up copy of their 1905 publication, entitled "Automatic Fire Protection." The May-Oatway system of automatic fire alarms is fully described. Attention is drawn to the recommendations for the provision of buckets of water; this is almost useless to a sleeping household, but nevertheless this is still laid down by insurance experts. Throughout the booklet representative industries are shown, and reference made to facts and figures, and it contains much information of interest relating to the question of fire protection.

The Electrical Co., Ltd., 162, Shaftesbury Avenue, W.C., have sent us a leaflet relating to their "Ideal" candle fitting.

We have received from Messrs. Hardy & Padmore, Ltd., Worcester Foundry, Worcester, some sheets giving full size sections of the manholes and inspection pit covers that they are now making. This is a new departure, and should be of much assistance to consulting and other engineers.

Messrs. Johnson & Phillips, Victoria Works, Old Charlton, have sent us a small pamphlet illustrating their specialities in cables and junction boxes, &c.

The Electric Heating Co., 3, Holborn Place, W.C., have issued a price list of the "Phœnix" electric heaters, of which they are the sole manufacturers. Many articles of domestic use are priced and illustrated, including cooking ranges and accessories, radiators, &c.

A small illustrated booklet has just been issued by Messrs. Graham, Morton & Co., Ltd., Hunslet, Leeds, describing their system of cable-ways, cantilever cranes, electric telpherage, aerial ropeways, &c.

The General Electric Co., 71, Queen Victoria Street, E.C., have just issued a new canvas-covered edition of their "Union" steel conduit list. The company states that a satisfactory method for lining the conduit and joint boxes, &c., has now been devised by using a mineral compound, which is spread evenly over the interior of the fittings before enamelling; they are then steeped in enamel and stoved. Nipples for fitting together, made of a non-rustable alloy similar to type metal, are recommended for use with this conduit. Other "Union" fittings are listed, a new departure being in fitting adaptors by means of which oval tubing can be run direct from the fittings.

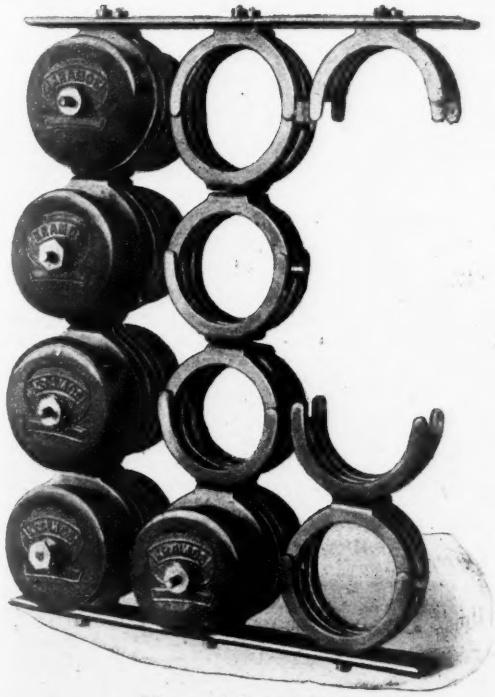
The Sunbeam Lamp Co., Ltd., Park Road, Gateshead-upon-Tyne, have sent us pamphlets relating to switch-type fuse boxes, cable sockets and voltmeter switches. These are manufactured by Messrs. A. Reyrolle & Co., Ltd., of Hebburn-on-Tyne, for which firm the Sunbeam Lamp Co. act as sole selling agents. We learn that the special motor starter of Messrs. Reyrolle, since it was put on the market, has met with much success, and that the company have large orders for this particular starter in hand. The first-mentioned company solicit inquiries for these lines.

A price sheet has come to hand from Messrs. E. F. Moy, Ltd., detailing their double-pole knife switches, type 49, fitted in cast-iron cases, and suitable for pressures up to 550 volts.

We have received from Messrs. Cutting Bros., Ltd., Stamford, a small card calling attention to their change of address, and also giving prices, &c., of their electric motors.

The Bell Rock Belting Co., of 24, Brazennose Street, Manchester, have forwarded us a varnished graphic calculation sheet, for determining the dimensions of leather belting required to transmit given horse-powers at given speeds. This will doubtless prove a welcome acquisition for the drawing office.

"Kramos" Patent Resistances.—We have received from Messrs. Kramos, Ltd., of Bath, a list dealing with their patent electrical resistance pieces. The material used in the manufacture of these is an electro-ceramic product; it is stated to be infusible and non-inductive. The pieces are made up in



"Kramos" Resistances.

the form of a cylinder covered with mica, and having a non-metallic cap at each end, from which protrudes a brass bolt and terminal. Each piece, we gather, can be made with any resistance between 0·5 and 300 ohms; they are all of one standard size regardless of high or low resistance. With excessive and continuous overload the resistance increases until it finally breaks circuit, this interruption taking place in the interior of the piece, without any outward sign of fusing, &c., and by this it is claimed that no damage can be caused to other parts of the circuit. The company states that these resistance pieces will carry a light load continuously, but if the load is applied for short periods only they will carry a considerably heavier one. Our illustration shows a resistance made up of "Kramos" pieces. Fuller details are given in the company's list, four classes of resistance being mentioned for regulators permanently under load, for controllers for frequent intermittent loads, for motor starters for heavy loads, for short periods with long intervals of rest, and for H.T. loads requiring high non-inductive resistances, or for the absorption of self-induction currents.

Callender's Hospital Fund.—We have received a copy of the report of this fund for 1904. The employés of Callender's Cable and Construction Co. subscribed in pennies during the year £268 in aid of this fund, which is for hospital and distress purposes, and £76 was received in donations from the firm and others. £211 of the fund was disbursed to a number of hospitals, and to the Surgical Aid Society, &c., in proportion to the call made upon these institutions by the members contributing to the fund, and £111 was granted to members to tide them over temporary difficulties. The existence of such a fund as this must be a boon to many a man in the course of a year.

South Africa.—The South African Customs authorities have lately given a decision to the effect that the duty on electric wire is to be rated at 2½ per cent. *ad valorem*, and on cut-outs (electric fittings) 10 per cent.

Annual Festivities.—Messrs. Anderson & Munro, electrical engineers, held their annual gathering and dance on Friday last in the Masonic Chambers, Glasgow. There was a large company of employés and friends present. It was remarked, as evidence of the ever-increasing uses of electricity, that 1904 was the most successful of the 65 years of the firm's existence.

Warehouse Premises. — Some extensive premises at 222, Upper Thames Street, E.C., are to be let on lease, and some particulars appear in our advertisement pages to-day.

Motor Medal.—Messrs. Brown Bros., of Great Eastern Street, E.C., inform us that the Brown motor-car has obtained a silver medal for elegance over 85 competitors at the Turin Motor Exhibition.

Brush Contracts.—The following new contracts have been booked by the Brush Electrical Engineering Co., Ltd. :—

Twelve Brush motor equipments for the Swansea Improvements and Tramways Co.

Fourteen double-deck car-bodies (seven with top-deck covers) ordered by the British Westinghouse Co. (for Erith).

Five car-bodies complete with trucks for the Chatham and District Tramways (per B.T.H. Co.).

Ferranti Contracts.—The Islington Borough Council has placed an order for seven 30-kw. single-phase transformers with Messrs. Ferranti, Ltd. The same company has also received orders recently for three-phase and single-phase transformers from :—The Midland Electric Corporation for Power Distribution, Ltd. (10 boosters); Bloemfontein Corporation; Eccles Corporation; Messrs. Bruce Peebles & Co., Ltd., &c.

Grease Separators.—Messrs. Davis-Perrett, Ltd., of 13, Fenchurch Avenue, E.C., have just received an order from the Dublin United Tramway Co. for one of their electrical grease-separating plants capable of purifying 4,000 gallons of greasy water per hour. Mr. H. F. Parshall is the consulting engineer. The same firm has just installed a large plant at the South London Electric Supply Corporation's Works at Loughborough Junction to deal with 8,000 gallons of greasy water per hour, Messrs. Kincaid, Waller, Manville & Dawson being the consulting engineers.

Football Match.—On Wednesday afternoon, February 1st, a return match was played on the ground of the Reading Football Club at Elm Park, between the Reading Corporation Tramways and the London United Tramways. There was a good attendance of the public together with many members of the Corporation, and a well-contested game ended in a win for the Reading men by 6 goals to 0. In the evening both teams were entertained through the kind generosity of Mr. Councillor Bull, chairman of the Tramways Committee, and after a hearty vote of thanks had been proposed by Mr. W. Binns, the general manager and engineer of the tramways, which Mr. Bull suitably acknowledged, the remainder of the evening was given up to a smoking concert. The above is the fourth match played with the London United Tramways Co., each club previously winning games on its own ground by 3 goals to 2, but the superior combination of the Reading men on February 1st resulted in a more substantial victory.

Book Notices.—*Steam: Its Generation and Use.* Fifth British edition. — Messrs. Babcock & Wilcox, Ltd., have sent us a copy of their new edition of *Steam*, which, although it deals almost exclusively with their own boilers, contains so much information of value to the engineer that it is well worthy of notice here. It may even be said, indeed, having regard to the enormous number of B. & W. boilers installed in electrical and engineering works of all descriptions, that the book largely derives its value from the very fact of its being devoted to the two types of boiler made by the firm. Besides a number of additional tables and data, and many fresh illustrations, including such installations as Lot's Road, Carville, Brimsdown, &c., new information on refuse destructors and superheating has been inserted. It is to be regretted, we think, that the

section on "Fuel and Furnaces" has not also been revised. In this section it is stated that "the rate of combustion should be correctly proportioned to the intensity of draught, to enable combustion of the volatile gases to be effected. Where these conditions are not studied, the unconsumed gases come into contact with the boiler heating surface, become chilled, and produce soot and smoke."—Quite so. But what is the remedy?—"Once the combustion is so impaired as to produce this smoke, it cannot be burned, and the only cure is to reduce the rate of firing or increase the draught." The rate of combustion is one thing, and the space allowed for it to be completed in is another. The true remedy—ample space, with uncooled walls, for combustion to take place at a high temperature—is not mentioned. The question of superheating also receives unsatisfactory treatment. The value of the book as a whole, however, is unquestionable, and we have no doubt that Messrs. Babcock & Wilcox will receive a vast number of applications for copies.

Private House Electric Lighting. By Fred. H. Taylor. London: Percival Marshall & Co. 1904. Price 1s. net.—This is a capital little work, intended not so much for professional electricians as for amateurs, having originally been published as a series of articles in the *Model Engineer and Electrician*. The author describes and discusses the usual casing and tubing systems, which always bulk so largely in wiring matters, deals with the jointing of wires and cables (which really is not nowadays of anything like the importance that it used to be) and explains the arrangement of lamps and switches in the various apartments of a dwelling house. Testing, accessories, materials, and the cost of installations are treated of in turn, and there is a short section on generating plant. The book is a useful addition to the literature on this subject.

The *Pall Mall Magazine* for February contains a well-illustrated article, by Mr. S. L. Hughes, on the Lots' Road power station of the Underground Electric Railways Co., Ltd. It is written in an interesting style to suit the lay public, and a perusal of this account of the large undertaking now nearing completion at Chelsea will give a good idea of the work entailed, and of the up-to-date methods about to be employed for the running of the Metropolitan District, the Metropolitan Railway, and other companies' trains in and about the metropolis.

"The Imperial Directory and Statistics of Electric Lighting, Power and Traction Works in Operation or Projected in Great Britain and Ireland, India and the British Colonies for 1905." Edited and compiled by C. S. Vesey Brown. London: Hazell, Watson & Viney. 12s. 6d. net.

"The American Institute of Architects' Quarterly Bulletin." October, 1904. Washington, U.S.A.: The Secretary, A.I.A.

"Science Abstracts." January 25th, 1905. Vol. 8, part I. Sections A and B, and Index to Vol. 7—Section A. London: E. & F. N. Spon. 1s. 6d. each net.

"Petrol Motors." By T. H. Hawley. London: Percival Marshall and Co. 1s. net.

"Telephones and Telegraphs in the United States." Census statistics to December, 1902. Washington: Government Printing Office.

"Elektrische Traktion." By G. Sattler. Hanover: Gebrüder Jänecke. 4 20 M.

We understand that Garcke's "Manual of Electrical Undertakings" for 1905 will be published in a few days.

LIGHTING AND POWER NOTES.

Aberdeen.—The members of the Town Council made an inspection recently of the Corporation Electricity Works and the extension of the subway from Holburn Street to Crown Street, the length of which is 780 yards; this was built in 13 months at a cost of £10,200. The works and machinery, it is estimated, cost £250,000.

Australia.—ADELAIDE.—We mentioned in the REVIEW last week that the City Council had accepted the tender of the S.A. Electric Light Co. for street lighting. We gather that for the past five years the company has maintained 30 arcs of 2,000 C.P. each in the principal streets free of cost to the Council, and that this was conditional to their original right to carry wires through the city. This agreement expired in January, and the Council called for tenders for street lighting. The S.A. Gas Co. quoted £864 per annum and the Kitson Light Co. £1,934, as against £640 per annum by the E.L. Co.

Bacup.—The T.C. is negotiating with the Lancashire Electric Power Co. for a supply of energy to the district.

Belfast.—The question of lighting the streets by electricity, where tramway poles are to be placed in the centre, has been considered by the Council and referred back. It was stated that by electricity the cost would be £2,094 per annum, against £763 for gas.

The revenue from the Corporation electricity supply during 1904 amounts to £28,103, as against £25,496 in 1903, an increase of £2,686, or 10½ per cent.

Bo'ness.—The electricity works which have been erected by the T.C. were opened on Monday last. The contractors were the National Electric Construction Co., and the scheme has cost £25,000. Nine miles of cable have been laid for public and private lighting.

Bognor.—The U.D.C. has received from the B. of T. an intimation that the consideration of the question of revoking the E.L. Order has been deferred for six months from December 31st, last.

Carnarvon.—The Corporation electricity works are nearing completion. The principal plant consists of two Davey-Paxman Economic boilers of 7,000 lb. per hour evaporative capacity; two Peache-L.D. & M. Co. 100-KW. generating sets; a Hart battery of 400 ampere-hours capacity, and a Green economiser. Cables have already been laid in the principal streets, and it is proposed to extend them along Llanbeblig and South Roads and St. David's Road. The supply is arranged on the three-wire continuous-current system at 460 volts between outers. The prices to be charged are 5d. per unit for lighting, and 2½d. for power, with discounts. The National Electric Construction Co. has entered into an agreement with the Corporation to run the station when completed. Mr. Price F. White is the consulting engineer, and Mr. A. C. Goodman the resident engineer.

Cheltenham.—A L.G.B. inquiry was held last week relative to the application of the T.C. for a loan of £1,500 for the purchase of additional plant at the electricity works, to supply energy for the extended tramways. There was no opposition.

Continental Notes.—SPAIN.—The Lerida provincial authorities have received application for sanction to put down a water-power plant on the River Segre, for generating electricity for supplying light and power to Seros, Aytona and Mesalcoreig.

GERMANY.—The Lokstedt municipality, near Altona, has decided to erect an electricity works in the town.

PARIS.—Some days ago it was reported that a strike of the electric light operatives in the city threatened to become serious. The Republican Guard was assisting the police and mounting guard over the electric light switches in the streets. At a general meeting of the electric light operatives at the Labour Exchange, the men voted a general strike, to be decreed at such a time as the committee should decide. It was feared that as soon as the decision became known to the men who for a whole week had been shut up in the electrical works at St. Denis, they would leave the works, and that the whole of central Paris would be plunged into darkness.

Darlington.—Extensions to the electricity works are anticipated. The T.C., on the recommendation of its Electricity Committee, has decided to call for tenders for a supply of motors on the hire-purchase system.

Dewsbury.—The T.C. has refused the request of the Yorkshire Electric Power Co. for permission to supply energy to a colliery in the borough.

Dover.—The T.C. has received intimation that the application for a prov. order to supply energy to parishes outside the borough will be opposed by the South-Eastern and Chatham Railway Co., the Dover Gas Co., and the Kent Electric Power Co.

Edinburgh.—The E.L. Committee of the T.C. on 31st ult. considered a report by Prof. Kennedy on the proposed extension of plant at M'Donald Road station, and it was agreed to recommend the Council to authorise an extension at a probable cost of £8,000.

Egremont.—The B. of T. has informed the U.D.C. that consideration of the question of revoking the E.L. order will be deferred until January 4th, 1906. It is intimated, however, that if during the ensuing year the Council is unable to satisfy the Board that there is a definite proposal to give effect to the order, the Board will not be prepared to allow the order to remain in force any longer.

Fenton.—With the object of getting a supply of energy in bulk from the Stoke-on-Trent T.C., the U.D.C. has decided to ascertain the probable number of consumers for lighting and power.

Halesowen.—The B. of T. has informed the U.D.C. that whilst the question of revoking the electric lighting order will be deferred until September 30th, 1905, the Board will then immediately revoke it unless a definite scheme is adopted in the interim. As the Empire Electric Light Co. has obtained a lease of the order, the Council has informed the company of the Board of Trade's action.

Halifax.—A new generating set, provided at a total cost of £6,631, was started on 1st inst. at the Corporation electricity works by the Mayor, bringing up the total capacity of the plant to 4,500 KW. Even now, however, the margin over the greatest demand is not a large one. As a compliment to the Mayor, the engine was christened "Enoch Robinson."

Ilkley.—In reply to a letter from the B. of T. as to what steps are being taken to carry out the E.L. order of 1901, the U.D.C. has stated that the Yorkshire Electric Power Co. is about to erect a station at Bingley, and that the Council's action will be decided upon when the station is completed.

Little Lever.—The U.D.C. has appointed a special committee to consider an application made by the Lancashire Electric Power Co., for the Council to enter into an agreement with the company for a supply of energy under the prov. order being applied for by the Council.

Liverpool.—The Corporation electric supply accounts for last year have been issued, and show that the income on revenue account totalled £236,404, of which £135,631 was from electrical energy for lighting and power, £2,371 from public street lighting, and £91,674 from tramways. The total works costs amounted to £97,830, leaving a gross profit of £138,574. The net profit amounted to £44,510, out of which it has been resolved to transfer £16,285 to the reserve fund, £11,289 to the renewal fund, and £16,934 to the general district rate.

London.—Chelsea.—In regard to the application of the B.C. for sanction to borrow money to erect public baths and equip them with a private electrical plant, the B. of T. has written stating that the Council would be well advised to reconsider the latter question, and suggesting that it would be more economical to purchase a supply of energy, than to provide an installation as proposed.

Islington.—The B.C. has resolved to borrow £39,030 on short term mortgages. £30,941 of this sum is for the electricity works, and £1,026 for arc lamps and columns.

Battersea.—The Electricity Committee has been in communication with the L. & S.W.R. Co. regarding a supply of energy to the Nine Elms goods yard, and the company has intimated its willingness to take a supply and guarantee a consumption, for five years, of 200,000 units per annum, on terms to be agreed. The company may, at a later date, require a much larger quantity. In connection with this matter, the electrical engineer has been instructed to prepare a scheme for lighting the whole of Nine Elms Ward by electricity.

Bermondsey.—The Surrey Commercial Dock Co. has applied to the B.C. for a supply of energy to the Acorn Yard and Commercial Yard, 83 amperes to the former and 400 amperes by April to the latter. The engineer has informed the Council that it could supply 83 amps. and 300 amps. respectively to the Co., and the cost of mains would be £264 to Acorn Yard, and £142 to Commercial Yard, and the Council has agreed to supply on the rates recently quoted to the company. The electrical engineer also reported that he had been in communication with the S.E. & C.R., in regard to a special tariff for supply to the staircases and areas of the artisans' dwellings in Abbey Street, and in consideration of energy being consumed during all the hours of darkness, the street lighting rate of 3d. per unit is to be charged.

Hammersmith.—A loan of £18,482 for electric lighting purposes has been taken up.

Westminster.—A writ has been issued against the C.C. at the instance of the Westminster Electric Supply Corporation, Ltd., for the return of the sum of £1,638, alleged to have been overcharged for reinstating streets disturbed by trenches in 1901 and 1902, and such further sum as may be adjudged to have been overcharged in respect of a charge of 10 per cent. on the amount expended on reinstatement, for supervision of such reinstatement work. The solicitors for the Council have been instructed to defend the action.

Lytham.—The U.D.C. has given consent to the application of Messrs. Foote & Milne, Ltd., for powers to supply electrical energy in the district.

Macclesfield.—As the result of a visit of a deputation to the B. of T., the T.C. has been informed that the electric lighting order will not be revoked without the Corporation having an opportunity of appearing before the Board. Messrs. Foote and Milne, Ltd., having asked the B. of T. to revoke the order and to dispense with the Council's consent to their application for a prov. order, the T.C. has replied, informing the Board that steps are being taken with a view to putting the order into force. A scheme of electric lighting to cost not over £16,000, is to be prepared by the Electricity Committee, and it has been decided to invite Mr. J. H. Woodward, of Messrs. Preece & Cardew, to meet the Committee.

Nantwich.—The B. of T. has asked the U.D.C. what steps have been taken to carry into effect the E.L. order obtained in 1900, and a reply is to be prepared by a Committee.

New York City.—Plans have been approved for the erection, within four months, of an experimental electric lighting plant at the Manhattan end of the Williamsburg Bridge, for the purpose of supplying energy for lighting that structure and a few adjacent city buildings. Boilers of 400 H.P. will be installed, and city refuse will be partly or wholly utilised for fuel. The plant is estimated to cost £15,000, and it is hoped to demonstrate, even if coal is used, a saving of about 40 per cent. on the present method of lighting the bridge from the mains of the Edison companies.

Plymouth.—The Electricity Committee of the T.C. inspected the electricity works at Prince Rock, the visit having been recently organised for the benefit of new members.

Southampton.—The borough electrical engineer has reported that the capital expenditure on machinery for the new station on the Western Shore, works out at the low figure of £12 10s. per KW. installed, as compared with £26 per KW. installed in the old works. There is a net deficiency on machinery expenditure account of £374, and the Council has resolved to apply to the L.G.B. for sanction to borrow £6,300 to cover amounts expended in excess of loans sanctioned. On the electrical engineer's recommendation, the B.C. has decided not to set aside a fixed percentage on capital outlay, for depreciation at present.

Stourbridge.—The Midland Electric Corporation for Power Distribution, Ltd., has notified the U.D.C. of its intention to apply for powers to supply and distribute energy in bulk in the Council's district. Application is also made by agreement with the U.D.C. to revive or extend the time limited by the Council's electric lighting order, 1899.

Stretford.—New plant has recently been put down at the electricity works to provide energy for the proposed tramway to Chorlton-cum-Hardy, as well as to cope with the demand for private supply. In the agreement between the Trafford Park Electric Power Co. and the U.D.C., an arrangement has been provisionally made by which the electric lighting in the residential portion of Trafford Park is to be undertaken by the local authority. The Electricity Committee propose to reduce the charge for energy to private consumers from 6d. to 4½d. per unit. Provision has also been made for working the southern tramway extension to Urmston when the line is constructed. The total cost of the additional plant at the U.D.C. electricity works is £6,500.

Sunderland.—The Corporation is to lay mains for supplying energy to Messrs. Laing's and Messrs. Short's shipyards, and part of the loan mentioned last week as being applied for, is to cover the cost of this work.

Willesden.—The sub-committee appointed to raise a loan of £31,841 for electric lighting purposes, has accepted an offer at £3 16s. 3d. per cent. per annum. The U.D.C. has resolved to purchase a plot of land in Taylor's Lane, at a cost of £850, as a site for a sub-station, the vendor of which has given the Council first option of purchasing other adjoining plots. An agreement for the purchase of a site for electricity works at Neasden has been approved with some amendments. Complaints are being made regarding noise and vibration from the North Metropolitan Power Supply Co.'s power station in Taylor's Lane. The accounts rendered by this company to the Council for energy supplied during the last quarter show as follows:—Public lighting, 75,378 units at ·73d., £229; power supply, 24,138 units at ·9d., £91; general supply, 289,781 units at 1·22, £1,476.

TRAMWAY AND RAILWAY NOTES.

Barnet.—The electric tramway from the Highgate Archway to Barnet, passing through Finchley and Whetstone, is now nearing completion. It is hoped, says an evening contemporary, that an efficient service of cars may be ready within a few weeks.

Belfast.—On Monday proceedings were commenced at the Surveyors' Institution, Westminster, before Mr. L. L. Macassey, sitting as sole arbitrator between the Belfast Tramways Co. and the Corporation, arising out the purchase of the company's undertaking. The claim included an item of £345,971 for the company's undertaking, about £20,000 for two other undertakings, £74,216 for three years' unexpired profits, and £7,500 for compensation to directors, manager, and secretary. The full figure was £452,395, but deducting the amount of the principal moneys secured by the company's outstanding debentures (£60,000) the total claim was £392,345.

Birmingham.—The provisional terms arranged with the City of Birmingham Tramways Co. for the purchase of lines belonging to the company within the city, the reconstruction of the steam and horse routes leased to the company until December 31st, 1906, and the purchase of the Kyotts Lake Road depôt, were recently approved by the T.C.

The Committee had agreed to pay a sum of money which was based upon the real value of the Bulsall Heath tramways, but it included a release from all doubtful obligations to purchase rolling stock, the tramway depôts, and other matters which an arbitrator might have put upon the Corporation, under the Tramways Act, 1870. The terms were £20,000 for the Bulsall Heath lines, on condition that the Corporation was allowed to proceed with the electrification during the company's tenure of the lease; £16,000 for the Kyotts Lake Road depôt, with the provision that the Corporation should have so much of the depôt as it required after the middle of 1906, for the purpose of preparing electric cars to start running on January 1st, 1907.

Bury.—It was stated at the Bury T.C. meeting last week that, in consequence of the Tramway Bill having been disallowed at a former meeting of the Council, a part of the Bury and Radcliffe scheme would have to be abandoned. This, the chairman of the Tramways Committee (Major Hall) said, involved the dropping of the project for coupling up with Bolton. This scheme had previously been sanctioned by the T.C. without a single objection being raised, Major Hall said, and in view of the arrangements with Bolton and Radcliffe, the Committee had serious ground of complaint that "a vacillating and weak-kneed policy" should now commend itself to a majority in the Council. The Committee's minutes were confirmed.

Cardiff.—At the annual meeting of the Property Owners' and Ratepayers' Association last week, the president (Mr. A. Beasley, general manager of the Taff Vale Railway Co.) pointed out that the municipal debt at Cardiff had increased from £1,460,718, or £11 6s. 7d. per head of population, in 1894 to £3,352,393, or £20 8s. per head, in 1904, to which about £147,600 had been added between March and November last. The *Times* report says:—"The total outlay on the tramways was in March, 1904, £687,222, and in December the cost was stated at £726,858, which worked out at £33,000 per mile as against the average for the United Kingdom, as per the Blue Book return, of £15,000 per mile. They had bought cars in excess of the requirements, and the receipts were stationary. On electric lighting the expenditure exceeded £200,000, and only

£500 had been placed to depreciation, and what were regarded as profits were no profits at all."

Chatham & Dover Railway.—At the ordinary half-yearly general meeting of the above company, held on the 3rd inst., Sir Edward Pemberton, the chairman, referred to the serious decrease in passenger traffic which that company had suffered in common with similar undertakings. The decrease was attributed, among other things, to tramway competition in South London; under the circumstances, the directors had decided to make an effort to develop districts further out where tramway competition could not be felt, and many additional trains had been put on with that object. The chairman also referred to the Brighton Co.'s electrical experiments, which, if successful, might result in the ultimate electrifying of the Metropolitan sections of their railway. In connection with the above, notices have been posted on the stations of the South-Eastern & Chatham Railway, announcing the withdrawal of certain early workmen's trains running from Victoria to Ludgate Hill.

Croydon.—A poll has been taken of the ratepayers upon the proposal of the Corporation to spend some £130,000 in extending the tramway system to Upper Norwood. Out of a total poll of about 7,000, those in favour obtained a majority of 88.

Electric Mono-Railway to the Sussex Coast.—A working model of the Kearney-Thom electric mono-rail system (which is to be used on the proposed London and Sussex railway) has been on view at the recent Electrical Exhibition held at the Battersea Town Hall. Mr. E. W. Chalmers Kearney explained the syndicate's proposal to build a London suburb on the Sussex coast, which, it is estimated, will be within 30 minutes' journey of town, by the above railway system. Two alternative plans are suggested—either to tunnel down beneath the City and South London Railway at the Bank, and proceed underground for three miles, or to make Cannon Street the starting point, and construct the entire line overground. During the present year a practical demonstration of the system will be given on a specially constructed mile of track on private property. Plans have been prepared for the prospective seaside suburb, and the idea is to provide energy from two power stations—one 10 miles out of London, and the other at the Sussex end of the line—upon which Mr. Kearney claims that a five-minute service could with perfect safety be maintained.

Glasgow.—A deadlock has taken place between the Tramway Committee of the T.C. and the Partick T.C., as a result of which the proposed extensions of the cars through the latter burgh will be dropped from the prov. order promoted by Glasgow. Glasgow offered to construct the lines on the same terms as were conceded when the last extensions in the burgh took place, but these Partick refused, and the negotiations were broken off.

An interesting point was raised in one of the police-courts in Glasgow on Saturday, in regard to an electric car case. The driver of a car was charged with recklessly driving his vehicle, and a law agent, who appeared for him, objected to the case being tried before a magistrate who was a member of the City Tramways Committee. The objection was, however, repelled by the legal assessor. The charge was found not proven.

Liverpool Overhead Railway.—A big fire at a Bootle timber-yard on Monday last caused traffic between Alexandra Dock Station and Seaforth on this railway to be suspended. Firemen were kept constantly playing on the structure of the railway.

London.—The Court of Common Council on 2nd inst. discussed at length the proposal to lay tramways along the Embankment and over the bridges, &c. The Streets Committee recommended that the Corporation should not consent, but should take steps to oppose the L.C.C. Bill. The Court adopted this course by 97 votes to 33.

Maidstone.—On February 1st the B. of T. held an inquiry into the Corporation's application for a loan of £60,000 for electric tramway extensions, it being proposed to run a branch from High Street to Loose, and another from High Street to Penenden Heath. The only opposition was from a wholesale trader, who contended that one of the lines would be an obstruction to carriers' vans.

Newcastle-on-Tyne.—Mr. F. J. Edge, the city engineer, has just issued an interesting report on the condition of the track of the tramways. He finds that those portions which were laid without anchors are very much out of repair, more particularly where the routes are served with the heavy type of bogie car. A number of anchors have been put into the track, but this has been done only in such places as was necessary to effect repairs, no track having been taken in hand systematically, and anchored throughout. The city engineer recommended that the track should be systematically anchored, and the joints welded where necessary. He then proceeds to give details of the work required on each section, and the approximate cost. The totals are:—Anchors £1,282, joints £3,153 for the portions which are in urgent need of repair, and which should be done this year. The remainder, which might be left over for next year, would cost for anchors £1,632, and for joints £3,044. Since Mr. Edge has taken over the management of the line, he has found defects which will cost the system a sum of £9,111 during the next two years.

New York City.—The blizzard on January 25th was the worst of its kind since 1888, and resulted in a complete stoppage of all electric street traffic at an early hour of the afternoon. Traffic had not been entirely resumed up to January 27th.

North-Eastern Railway.—From the half-year's report of the above company, we gather that during that period, they carried on the Newcastle and Tynemouth suburban lines, which are now worked by electricity, 675,000 more passengers, between stations on those branches, than in the corresponding half of 1903. The directors consider that the results of substituting electricity for steam, for working the passenger traffic on the above lines, have so far been satisfactory, as regards receipts and expenses. The electric train mileage was 588,786.

Rathmines.—The extension line of the Dublin United Tramways Co. in Upper Rathmines was opened on January 27th.

Sunderland.—The T.C. has decided to appeal at the Quarter Sessions against the assessment of the tramways and electricity undertaking. The assessment of the former has been increased from £5,000 to £13,650 gross, and £11,550 net, and the latter to £8,055. The Corporation desires the assessment of the tramways undertaking to be reduced to £5,661, but the Assessment Committee will not go below £11,000.

West Bromwich.—Councillor Baggott recently gave notice that at the next meeting of the T.C. he will move a resolution to the effect that the Council take proceedings to compel the tramway company to carry out the terms of their agreement with the Corporation. Councillor Baggott pointed out the serious public inconvenience caused by the company running a 15 instead of a 10 minutes' service between Carter's Green and Great Bridge, and he urged that the outlying districts were entitled to share in the advantages of the ½d. stages. The Mayor explained that a deputation from the tramway company was about to wait upon the Corporation, and then a proper understanding would no doubt be come to as to the agreement. He added that the Corporation had no power to compel the company to adopt the ½d. stages in the outlying districts.

Willesden.—At a meeting of the U.D.C. recently it was reported that the promoters of the Metropolitan Electric Tramways Bill had intimated that they were prepared to insert a clause to the effect that nothing contained in the Bill should authorise any company, body, or person (other than the North Metropolitan Electric Power Supply Co.) except in cases of emergency, to supply power to the Tramway Co. for use within, or the Tramway Co. to use any such supply within, the urban district. It was further reported that the promoters of the North Metropolitan Electric Power Supply Bill had intimated their willingness to insert a clause to the effect that nothing in the Bill should authorise them to lay down or maintain any mains, cables, &c., in, or open, or interfere with, any streets in the urban district, or to supply electricity except in bulk for the purpose of traction. The Council's solicitor was instructed in both cases to arrange a settlement on the lines suggested, and to withdraw opposition to the Bills. The solicitor reported the result of his negotiations with the promoters of the Metropolitan Electric Supply Co. (Various Powers) Bill, and read a letter which he had received from the agents for the Bill, together with the clause and amendments which the promoters were prepared to insert for the protection of the Council. The solicitor was authorised to consult with counsel as to whether the Bill as proposed to be amended would affect the injunction granted by Mr. Justice Farwell on October 28th last, and if counsel is satisfied to arrange a settlement on the lines proposed.

Wolverhampton.—The following is a comparative statement of tramway traffic receipts:—

	Passengers carried.	Total receipts.	Receipts per car-mile. Passenger.	Parcel.	Total.
April 1st to Dec. 31st, 1904..	5,750,160	£28,002	11·280d.	·023d.	11·303d.
April 1st to Dec. 31st, 1903..	3,454,388	£17,873	11·089d.	·021d.	11·110d.

TELEGRAPH AND TELEPHONE NOTES.

C.S.S. "Cambria."—The trial trip of this steamer was carried out recently, when a speed of 13 knots was attained. This vessel has been built and engined by Messrs. Swan, Hunter and Wigham, Richardson, Ltd., to the order of the Telegraph Construction and Maintenance Co., Ltd. The same builders also constructed the *Colonia*. The new vessel is, however, much smaller, and is to be used for repairing purposes.

London's Overhead Wires.—At the Court of Common Council last week, Mr. Harold Leslie Dixon, inspector of overhead wires in the City, informed the Court that there were 40,000 miles of overhead wires in the City, the number of wires being 23 times more than when he was appointed, about four years ago. He was the only inspector in the City, but in Westminster there were three or four inspectors of overhead wires.

The Newfoundland Telegraph Award.—According to Reuter, the decision of the arbitrators in connection with the above awards Mr. Reid $1,503,100 (£300,620), with interest at the rate of 3 per cent. from October, 1903. The total sum is to be paid in cash before June 15th, and each side pays its own costs.

Telegrams to Vladivostok.—The Great Northern announce that as far as they are concerned, telegrams addressed from London to Vladivostok are being accepted for transmission as usual.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostok-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chifu	Mar. 9, 1304	
Paramaribo-Cayenne	July 13, 1904	
Jamaica-Colon	Jan. 5, 1905	
Olchleh-Medan	Jan. 25, 1905	Feb. 3
Marmaritza-Rhodes	Jan. 30, 1905	
Landlines.		
Cartagena-Baranquilla	Dec. 8, 1900	
Puerto-Barrios	July 28, 1902	
Kertch-Soutchoum	Sept. 27, 1904	
Rome-Pera	Jan. 27, 1905	
Bhamo route beyond Tali	Jan. 15, 1905	
Indo-European Kertsch-Kale	Jan. 31, 1905	Feb. 1

Telegraphs in Holland.—During the years of 1902 and 1903, says the *Journal Télégraphique*, the telegraphic system of Holland increased by 536·9 kilometres of line and 5,972·7 kilometres of wire, the totals on January 1st, 1904, being 6,780·3 kilometres of line and 29,603 of wire. Since 1899, the Administration abolished the use of iron, asphalte and earth conduits, and are eliminating all conduits of this kind still in existence. River and submarine cables during the two years have increased by 8,015 metres.

On January 29th, 1902, a ship's anchor damaged the Vlieland—Harlingen cable during a storm, and it was not repaired until March 13th following. During the close of the next year, communication by this cable was again interrupted, the fault being in the underground cable near Harlingen. The direction of the trench not being exactly known, it was necessary to resort to much digging and consequent expense.

On May 6th, 1902, the Zandvoort—Lowestoft cable was interrupted, and this was repaired by the British administration on May 23rd, the delay being caused by bad weather. This cable was also interrupted on December 15th to 22nd, 1902, and from October 23rd to November 13th, 1903. On November 24th the cable gave out again, and owing to bad weather was not repaired till June 1st, 1904. The Volkerak and Zuidersee cables were also interrupted several times. The following are the causes of interruptions :—

	1902.	1903.
Damaged posts	15	80
Damaged wires	180	296
Leakage	824	1,872
Contacts, crossed wires	1,262	2,150
Broken insulators and supports	32	77
Damaged carrying wires	16	22
Faults in water-ways and subterranean lines	43	76
Non-enumerated	266	465
Total	2,638	4,988

In 1902 the administration experimented with a composition named "Gentzsche Gutta" in the making of their cables, but at the end of the year they were not in a position to definitely pronounce on the practical value of this substance.

The destruction of insulators through stone-throwing did not cease in 1902, but to prevent this, insulators were used protected with an enamelled iron guard. This guard entirely covered the porcelain insulators, and was fixed to the latter by means of plaster of Paris. But this means of protection could only be adopted in a very restricted manner. The metallic covering adopted was quite practical in dry weather, but when the atmosphere was humid it became a cause of leakage, and constantly a serious obstacle to telegraphic communication when snowing or freezing.

By reason of the great increase in the number of insulators caused by the continual erection of new conductors, it became necessary to adopt some means of overcoming the strain on the posts, and to effect this a modification was introduced in the arms and double supports by which the stems of the insulators could be placed nearer together. This, of course, increases the risk of crossed wires, but up to the present no inconveniences of this nature have been experienced.

Lighthouses on the Islands of Ameland, Terschelling and Vlieland have been put into telegraphic touch with one another, and the authorities, as well as with lifeboat stations. In 1903 there were 1,815 operators and employés, of which 345 were women.

The number of telegrams was as follows :—

Year.	Telegrams.	Increase.
1899	2,716,485	1·5 per cent.
1900	2,799,910	3·07 ,,
1901	2,961,566	5·8 ,,
1902	2,970,897	0·3 ,,
1903	3,117,532	4·9 ,,

The average number of words per telegram was 14·48 in 1902, and 14·54 in 1903.

Telegrams for and from the United States of America were distributed as follows :—

	1902.	1903.
To Anglo-American cables	68,946	74,983
,, French-American cables	9,409	4,389
,, German-American cables	36,629	32,637

Telephones in Japan.—From the *Anglo-Japanese Gazette* we learn that telephonic communication in Tokyo and Yokohama was started in December, 1890, the number of subscribers at that time being about 200 in Tokyo and 40 in Yokohama. At the present time the country has 46 exchanges in operation with 36,700 subscribers. The seven largest exchanges, worked with multiple switchboards, are in Tokyo, Osaka, Kyoto, Yokohama, Kobe, Nogoya and Nagasaki, serving over 28,000 subscribers in a population of 3,920,000. In 1899 the automatic telephone was introduced, and in the towns above-mentioned there are 117 automatic telephone call offices in use. A telephone service between Tokyo and Sasebo—nearly 600 miles apart—was opened in December last.

Wireless Telegraphy.—The London, Brighton and South Coast Railway Co. began on Wednesday last week a series of experiments in wireless cross-Channel messages between Newhaven and Dieppe. The results, so far, are very satisfactory, and, if similar success attends further tests, the system, in the course of a week or so, will be in full operation for a commercial service in connection with the company's boats. The system will entirely supersede the old and difficult wire telegraphy between Newhaven and Dieppe, which, by reason of an unavoidably circuitous route, occupied sometimes from four to five hours in transit. Under an agreement with the English and French Post Offices, the system adopted is that known as the Mors, and M. Rochefort fils is the engineer-in-charge of the installation carried out jointly by the London, Brighton and South Coast and the Western of France Railways.—*Times.*

According to the Post Office circular, the Marconi Co. wish it to be understood that in the event of failure no claims for refund can be entertained in respect of any telegrams accepted at senders' risk. It appears that some claims for refund of charges have been made by the public, although messages were sent at their risk, and did not reach their destination. Senders must take the risk of a message reaching the wireless station when handed in near the hour mentioned in the list opposite the name of the ship, and there is, therefore, some doubt as to the possibility of delivery.

CONTRACTS OPEN AND CLOSED.

OPEN.

Army Contracts.—The Secretary, War Office, is advertising for names of manufacturers who wish to tender for army requirements. See "Official Notices" February 3rd.

Ashton-under-Lyne. — February 16th. Deep well pump for the electricity works. See "Official Notices" February 3rd.

Barking Town. — February 10th. Boiler, pump, 400-kw. steam dynamo, switchboard panels, crane, &c., for the U.D.C. See "Official Notices" January 27th.

Batley.—February 20th. Tenders are required for wiring and fittings in connection with the electric light installation at the new central stores, now erecting for the Batley Co-operative Society, Ltd. Harry B. Buckley, Architect, 85, Commercial Street, Batley.

Battersea.—February 27th. Coal and other stores for the electricity department. See "Official Notices" to-day.

Belgium.—February 13th. Tenders are being invited until February 13th by the Municipal Authorities of Ghent for the supply of 15 electric cranes for use in connection with the docks. Tenders are to be sent to l'Hotel de Ville, Ghent, whence particulars may be obtained.

Belgium.—February 18th. Tenders are being invited until February 18th by the municipal authorities of Saventhem for the establishment of a central electric lighting station in the town. Tenders are to be sent to Le College des Bourgmestre et Echerins, Saventhem, Belgium, whence particulars may be obtained for 4 fr.

Blackburn.—February 16th. Stores for the electricity and tramway departments. See "Official Notices" February 3rd.

Bury.—February 14th. One 500-kw. direct-current high speed generating set, for extensions. See "Official Notices' January 27th.

Dublin.—February 23rd. Arc lamp carbons for the Corporation. See "Official Notices" February 3rd.

East Ham.—February 21st. Five double-deck roof-covered cars, complete. See "Official Notices" to-day.

Fulham.—February 22nd. Condensing plant, boilers, economisers and stokers for the Electricity Department. See "Official Notices" to-day.

G. W. Railway.—March 13th. Plant (three-phase and direct current) for the proposed sub-stations and distributing centres in connection with the Park Royal generating station. See "Official Notices" to-day.

Islington.—February 23rd. Electrical and engineers' stores for the electricity department. See "Official Notices" to-day.

Johannesburg.—March 6th. 100 electric cars, two electric water cars, five-ton crane, car traverser, and workshop tools, for the Municipal Council. See "Official Notices" December 30th.

Kilkenny.—February 20th. Installation of tell-tales for the District Lunatic Asylum. See "Official Notices" to-day.

Leek.—February 20th. Wiring and fitting the Town Hall for the U.D.C. See "Official Notices" January 27th.

Leith.—February 15th. One 600-KW. steam dynamo, water-tube boiler, and traction switchboard for the Corporation. See "Official Notices" January 27th.

Manchester.—February 14th. Main switchboard, and auxiliary distribution boards for the Corporation car-repairing works. See "Official Notices" February 3rd.

Manchester.—February 21st. Motor-generators and five-wire balancers for the electricity department. See "Official Notices" February 3rd.

Newport (Mon.).—February 14th. Fire alarms, telephones, &c., for the County Borough Asylum. See "Official Notices" February 3rd.

Porto (Portugal).—March 15th. The Town Council has opened a competition for the concession for the exclusive right of working the tramways for collective transports of passengers, luggage, and goods in all the municipal public ways. The conditions of the competition are published at the Portuguese Consulate in London.

Rathmines.—February 20th. Coal and other stores for the electricity department. See "Official Notices" to-day.

Salford.—February 18th. Stores, &c., for the electricity department. See "Official Notices" February 3rd.

Shanghai.—March 31st. Construction and working of 24 miles of electric tramways on the trolley system, double or single. See "Official Notices" October 14th.

Sheffield.—February 18th. Tramway stores. See "Official Notices" February 3rd.

Spain.—March 1st. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until March 1st for the concession for the establishment and working of a telephone exchange in Albacete. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid.

South Shields.—February 20th. Permanent way and construction of track; rail bonds and bonding; conduits, cables, and overhead equipment for the Corporation. See "Official Notices" January 13th.

South Shields.—March 13th. Boiler, two vertical engines and 550-KW. traction generators, also traction switchboard for the Corporation. See "Official Notices" to-day.

Stockport.—February 15th. One 21-KW. tramway booster. See "Official Notices" January 27th.

Stoke Newington.—March 8th. Transformers, motor-generators, boosters, switchboards, battery, distributing mains. See "Official Notices" to-day.

Sunderland.—February 24th. Four 250-KW. synchronous three-phase motor-generators for the Electricity Department. See "Official Notices" to-day.

Swindon.—February 21st. Extensions to lighting switchboard, switch-panels, &c. See "Official Notices" February 3rd.

Wimbledon.—March 4th. Stores for the electricity department. See "Official Notices" to-day.

CLOSED.

Barnsley Hall Asylum.—The tender of Messrs. Lea and Warren, of Kettering, for E.L. plant and motors at this institution has been accepted.

Battersea.—The B.C. has accepted the following tenders:—

C. A. Parsons & Co., one 750-KW. turbo-generator	£4,680
Green & Sons, special fuel economiser (356 tubes)	495
General Electric Co., six double tariff meters	78

Bury (Lancs.).—The Joint Hospital Board has accepted the tender of Messrs. Ashworth & Parker, of Bury, for an engine for the hospital electric light supply.

Camberwell.—The Board of Guardians has accepted the tender of Messrs. Wells & Co. for the electric lighting installation at the new workhouse.

Chatham.—The following tenders have been received for wiring and fittings for St. John's Church, to the specification of Mr. John Hewitt, M.I.E.E.:—

Duncan, Watson & Co.	£230 5 0
E. Bulstrode	219 15 3
Cairns & Co.	215 8 0
Chard & Co.	214 15 0

It is not often that we come across a list of tenders for installation work where the prices are so close as these.

Dublin.—The T.C. on Monday accepted Messrs. Meldrum Bros.' tender for the large extension of their refuse destructor plant.

East Ham.—The Council has accepted the tender of Messrs. Meldrum Bros., Ltd., for the erection of six of their patent "Simplex" regenerator cells at the sewage works.

Horsham.—The U.D.C. has accepted the tender of Messrs. H. Lindfield & Sons, for extensions to the Electricity Works, at £350.

Northern Hospital.—The Metropolitan Asylums Board has received the following tenders for the installation of electric fire alarms at the Northern Hospital:—

Jackson Bros. (accepted)	£210 10 0
New System Private Telephone Co.	228 18 6
Cross & Cross	249 0 0
Lea, Son & Co.	251 0 0
R. Melhuish, Ltd.	262 0 0
Electrical Engineering & Maintenance Co.	295 0 0
G. Weston & Sons	298 0 0
J. Bryden & Sons	310 10 0
Lawrences, Ltd.	320 0 0
A. H. Marshall	320 0 0
Baxter & Impey	321 15 0
Cox-Walkers	338 0 0
Private Wire & Telephone Installation Co.	397 0 0
National Telephone Co., Ltd.	435 0 0
C. W. Were & Co.	450 0 0
Tilley Bros.	461 0 0
J. T. Halsey	468 8 6
G. & H. Turner	484 0 0
Tamplin & Makovski, Ltd.	490 0 0
Leggatt & Huett	650 0 0

The estimate of the engineer-in-chief was reported to be £340.

Rochdale.—The T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for the supply of a high-tension switchboard for the electricity works.

Salford.—The T.C. has accepted the tender of Mr. Bertram Thomas, of Manchester, for the supply of four reverse current circuit breakers, £17 10s. each.

Stockport.—The T.C. has accepted the tender of Walter Scott, Ltd., of Leeds, for the supply of tram rails (at £5 12s. 6d. per ton), fish-plates and tie-bars, and that of the British Insulated and Helsby Cables, Ltd., for cables, at £223 15s.

Warrington.—The T.C. has accepted the tender of Messrs. G. C. Milnes, Voss & Co., for the supply of four top-covers for tramcars, at £80 each, inclusive of new trolley poles.

FORTHCOMING EVENTS.

To-day's Arrangements.—At 4 p.m. Tramways and Light Railways Association. Meeting at the Society of Arts.

At 8 p.m. Physical Society. Annual General Meeting. Address by the President, Prof. J. H. Poynting, F.R.S., on "Radiation Pressure."

At 8 p.m. At Frascati's Restaurant. Special meeting of the Electrical Contractors' Association (Incorporated), London Section, to hear a paper by Mr. R. Tweedie Smith, on the "London County Council General Powers (Wiring) Bill, 1905." Contractors are urged to be present to sign a petition against the Bill.

Saturday, February 11th.—At 6.30 for 7 p.m. Junior Institution of Engineers. Coming-of-Age Dinner at the Hotel Cecil.

At 2 p.m. North of England Institute of Mining and Mechanical Engineers. General meeting.

At 2.45 p.m. I.E.E. (Students) visit to G.P.O. Central Telephone Exchange, E.C.

At 7.30 p.m. Birmingham and District Electric Club. Mr. E. R. Wood on "Starting and Speed Regulation of Electric Motors."

Monday, February 13th.—At 6.30 p.m. Junior Institution of Engineers. Visit to the Brockie-Pell Arc Lamp Co.'s works, Worship Street, E.C.

At 8 p.m. Society of Arts. Mr. Dugald Clerk on "Internal Combustion Engines."

Institution of Mechanical Engineers (Graduates). Lecture at the Manchester School of Technology, by Dr. J. F. Nicholson.

Tuesday, February 14th.—At 8 p.m. I.E.E. (Glasgow) meeting.

Wednesday, February 15th.—At 7.30 p.m. I.E.E. (Birmingham). Mr. A. C. Anderson, on "Applications of Electricity in Mines."

At 7.30 p.m. I.E.E. (Students) meeting. Mr. W. J. Williams on "The Electric Furnace."

At 2.30 p.m. I.C.E. (Students) visit to the Lot's Road Power Station of the Underground Electric Railways Co. of London.

Thursday, February 16th.—At 7.15 p.m. I.E.E. (Leeds). Mr. James Lord on "Permanent Way Construction and Depreciation."

Friday, February 17th.—At 7.30 p.m. N.E. Coast Institution of Engineers and Shipbuilders. Meeting.

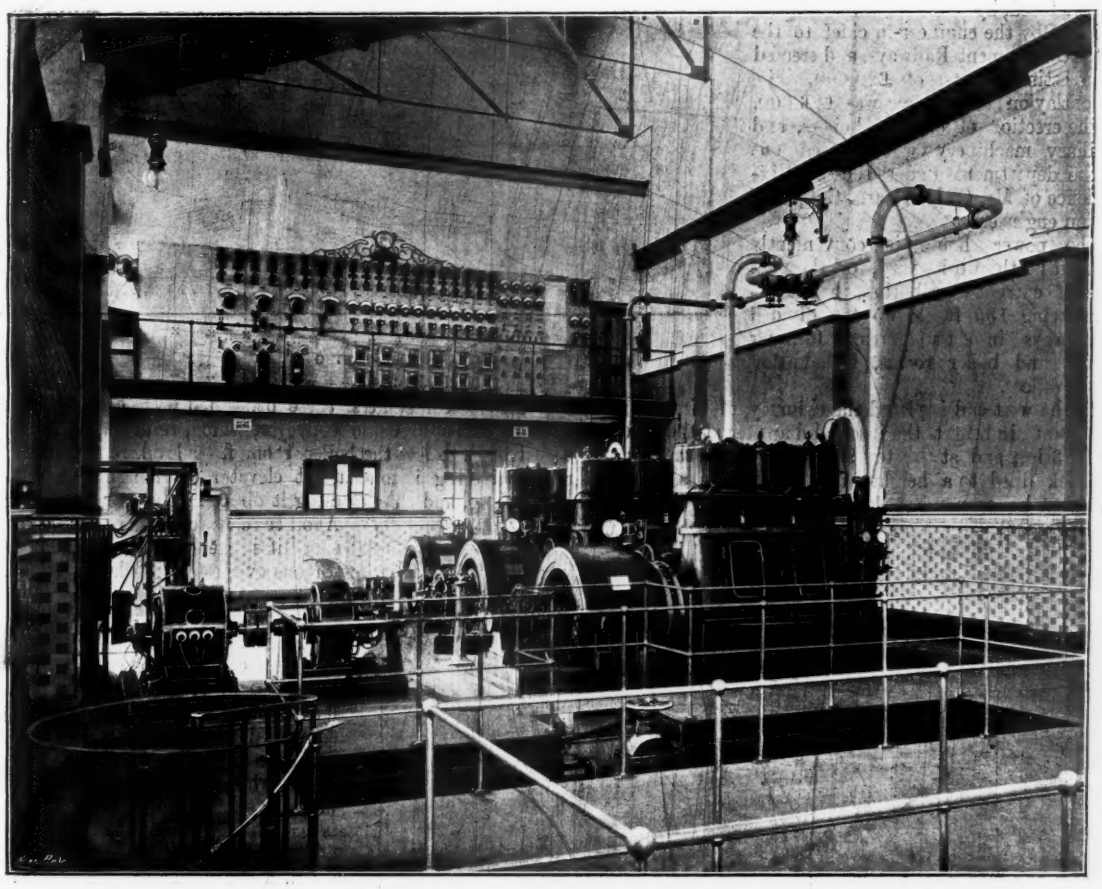
ELECTRICAL INSTALLATIONS OF THE NATAL GOVERNMENT RAILWAYS, SOUTH AFRICA.

[FROM OUR DURBAN CORRESPONDENT.]

The manifold uses to which electricity is put in connection with the railways of South Africa justify our giving a description of the new power station at Durban, the terminus of the Natal Government Railways, and headquarters of its electrical department.

Bearing in mind that this railway system only dates back to the year 1876, and that it was not until some six years later that a connection was made with the Transvaal (then the South African Republic), giving a total length of 304½ miles of main line, while the branch lines amount to about the same length, it is very gratifying to find electricity so much in demand. There are seven generating stations on the main line, for lighting and power purposes, as shown in the table given below.

During the late Boer War the electrical department of the railway was able to render useful service to the military authorities, in equipping searchlight, temporary lighting, and pumping plants, these being erected and run by them in connection with both active hostilities and the more peaceful works of bridge and permanent-way reconstruction.



Interior of Engine Room at Durban.

The original plant at Durban consisted of four 30-kw. E.C.C. dynamos, direct-coupled to "Peache" high-speed engines. The demand was chiefly for lighting, and it was on the decision to electrically equip the whole of the loco-

Station.	Date started.	Capacity.	System of supply and nature of load.
Durban ...	Old works 1896	120 kw.	D.C. 200 volts.
"	New works 1904	570 kw.	D.C. 200 volts, for lighting stations and goods yards, head offices, workshops, and driving all the machinery in the loco. and carriage works, charging train accumulators, and lighting Government buildings in the town.
Hill Crest...	1901	30 kw.	Three-phase A.C., 500 volts, 50 cycles, pumping plant.
Inchanga ...	1901	25 kw.	D.C. 100 volts, for local lighting and accumulator charging.
'Maritzburg	1902	310 kw.	Three-phase A.C. 2,200 volts, driving machinery in loco. shops, lighting station and goods yards, and accumulator charging.
Mooi River	1902	30 kw.	D.C. 200 volts, for lighting and pumping.
Ladysmith	1901	220 kw.	D.C. 200 volts, lighting station and goods yards, driving machinery in loco. shops and accumulator charging.
Charlestown	1903	30 kw.	D.C. 200 volts, for lighting station and accumulator charging.

motive works that the present new power station and scheme became necessary.

The general arrangement of the new central station, as well as the power and lighting distribution scheme for the railway works and for a running shed and repair shop at Greyville, was drawn up by Mr. Frederick W. Mills, A.M.I.E.E., the chief electrical engineer to the railways, and Government electrical engineer to the Colony, who also supplied the data from which the details were elaborated, on which tenders were called for in England.

The contract for the station equipment was placed with Messrs. Davey, Paxman and Co., Ltd., of Colchester, and was executed by them under the supervision of Mr. H. G. Humby, consulting engineer to the Natal Government.

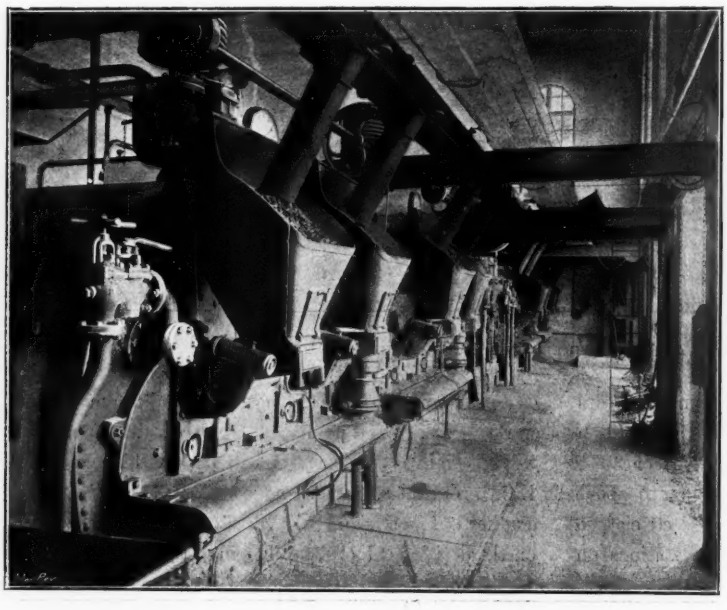
The building, which is of very lofty proportions, and was built of brick, cement faced, by a local contractor, was designed by the engineer-in-chief to the Natal Government Railways, and erected at an estimated cost of £20,000, while the outlay on station plant was £26,000.

The erection of engines, boilers, and auxiliary machinery was carried out by the department under the superintendence of Mr. C. H. Hearn, the power station engineer.

The power house is conveniently situated in the works yard, for the purpose of current distribution, the dimensions being 135 ft. × 85 ft., divided lengthways into two portions forming engine and boiler rooms, in addition to the offices.

Wood-Working Shop.

At the west end is placed the chimney, of circular section and 180 ft. in height, the internal diameter at the base being 15 ft. 3 in., and at the top 9 ft. 4 in. inside the cap; it is firebrick lined to a height of 115 ft., with a cellular air space. The economiser house is interposed between the end of the main building and the chimney, and measures 60 ft. × 30 ft.



Boilers and Mechanical Stokers.

A boiler room 135 ft. long × 50 ft. wide has been provided, with a view of ultimately doubling the present boiler power, consisting of five Lancashire boilers, 36 ft. long × 7 ft. 6 in. in diameter, with a grate area of 36 sq. ft. for both furnaces, generating steam at a pressure of 160 lb. per sq. in., and giving an evaporation of 6,000 gallons per hour with Natal nut coal.

Poulton's curvilinear bricks are employed for the boiler settings. On the floor level is situated the main flue, 8 ft. 6 in. × 5 ft. wide, bye-passed at the chimney base to four batteries of Green economisers, having a total of 394 tubes; the flue is so laid out as to permit of doubling the economiser in the future. The tube scrapers are motor-driven, with a small steam engine as stand-by.

All the boilers are fitted with "Bennis" sprinkling mechanical stokers, these being fed with coal by means of an overhead chain conveyor, which, returning in the ash-trough below the boiler room floor level, removes the ash, delivering it to a bucket elevator overhanging an adjacent siding, and thus ejecting it direct into steel railway wagons.

Another elevator of similar construction lifts the coal as dumped from wagons over a shoot, whence it falls by gravity into the elevator hopper.

An independently-fired superheater by Messrs. Davey, Paxman is set midway between the boilers; it has a capacity of 10,000 lb. of steam per hour, with a heating surface of 762 sq. ft., and is connected into the 10-in. saturated steam main by 8 in. branches, provision having been made for bye-passing or mixing as may be required. The steam is superheated to 500° F. The steam auxiliaries are supplied from a 3½-in. steam service taken separately from each boiler. The method adopted for supporting the steam ranges was a series of wrought-iron pipe columns surmounted by cast-iron cushion pieces by which the pipes were borne, the whole arrangement being very elastic, and no expansion joints or other devices being necessary.

The engine room, off which lead the offices, is 123 ft. long × 35 ft. wide, and is spanned by a 10-ton travelling crane; the walls are handsomely finished with a glazed tile dado, and the floors are also suitably tiled, the cable and other trenches being covered in by teak gratings.

At present three generating sets are in position and regularly working, with space for extension to double the present capacity; these are all of uniform size, viz., 190-KW. direct current, six-pole, compound-wound machines by Messrs. Bruce Peebles & Co., Ltd. They generate current at 210 volts, 500 r.p.m., and are direct-coupled to 300-I.H.P., triple-expansion, three-crank condensing engines, by Messrs. Belliss & Morcom. These are of their standard type, with forced lubrication throughout; as will be seen in the accom-

panying illustration, p. 227, an equalising switch is placed close to each machine for parallel running.

On the left-hand side of the same view will be seen the Brown-Boveri motor-generator, running at 1,000 r.p.m.; this supplies three-phase alternating current at 2,000 volts, 50 cycles, to Greyville depôt, where it is transformed down to 200 volts, and employed for lighting and power. The separate switchboard controlling this set is seen on the extreme left of the view.

Situated in the centre of the engine room at 10 ft. below floor level, and covered in by chequer plates, is the pump and condenser room; here are installed two motor-driven three-ram feed-pumps, each capable of dealing with 3,000 gallons of water per hour against 165 lb. per sq. in. pressure, and an additional Worthington vertical steam pump, Admiralty pattern, of equal capacity. In the centre of the pump room stands the condensing plant, with combined steam-driven air and circulating pumps. The displacement of the former is 10,123 cb. ft. per hour, while the latter deals with 83,500 gallons an hour. Here also are fitted the exhaust steam oil separator, hot-wells, oil filters &c.

A Worthington cooling tower is in use, having a capacity of 85,000 gallons per hour; its dimensions are 40 ft. high × 12 ft. in diameter, and the fan is motor-driven.

A lofty gallery running the full width of the engine room carries the main switchboard, supplied by Messrs. Kelvin and White, access to the platform being gained by a light iron spiral stairway of ornamental design. The main board consists of six generator panels, seven feeder panels, two arc panels, and one panel for testing purposes, all of white marble, and equipped with single-pole knife-switches, maximum and minimum circuit-breakers, and the usual dial and recording meters.

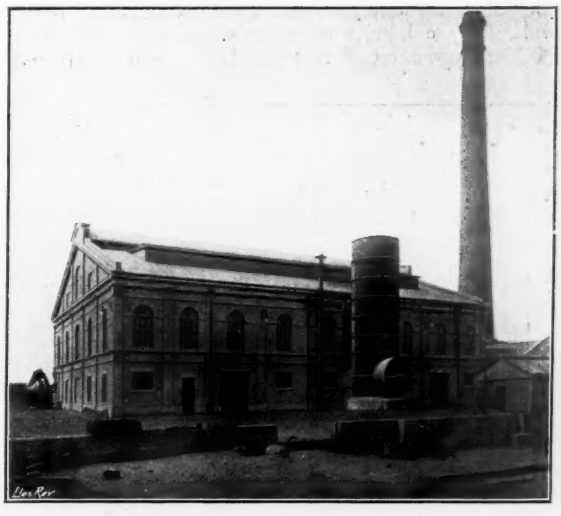
Behind the switchboard is the test room, suitably equipped by the same firm. The lighting of the station is carried out by G.E.C. enclosed series arc lamps, as well as incandescents.

The distribution scheme is carried out from the power station switchboard direct to three centres of supply, situated at the locomotive machine shops, carriage building shops, and traffic sub-station.

The feeders to these sub-stations consist of St. Helens 91/11 concentric paper-insulated cable, lead sheathed, of the 500-volt class, having a sectional area of 1·0 sq. in. These are supplemented by smaller feeders of 61/14 concentric paper-insulated cable of similar class, leading to the maintenance and stores departments.

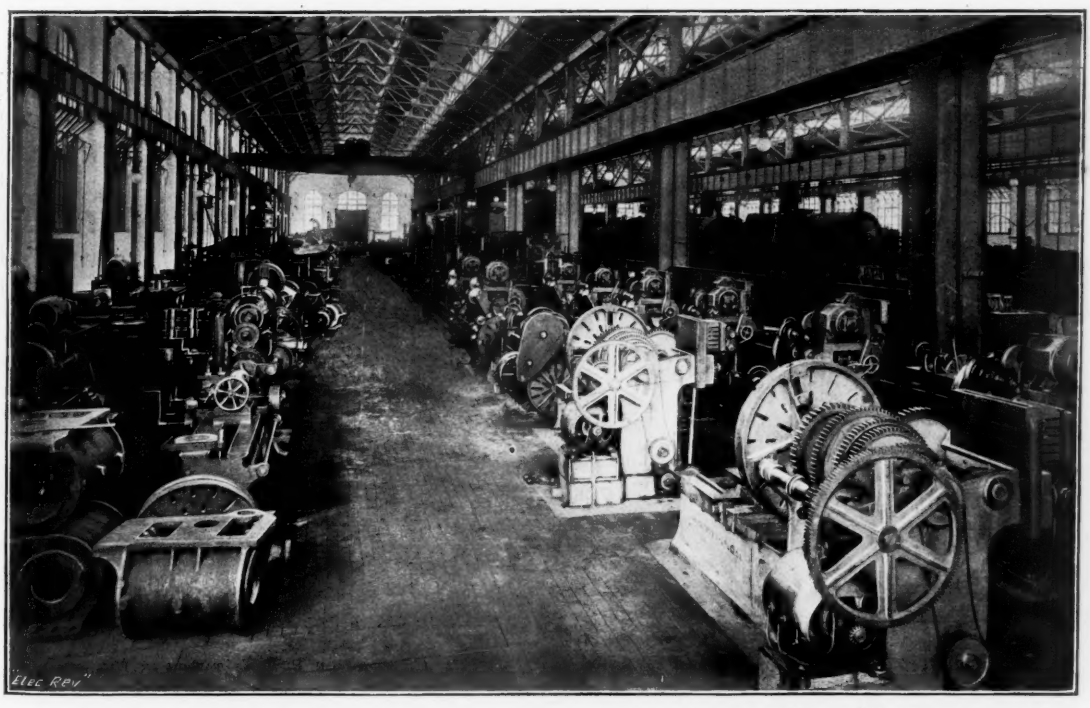
The high pressure supply to Greyville is conveyed by a 7/14 three-core armoured cable, 10,000-volt class, this being of sufficient sectional area to allow of an increasing load.

Altogether the system has involved the laying of four miles of cable serving 1,750 H.P. in motors, and an equivalent of 2,800 8-C.P. lamps in lighting.



Exterior of Power Station.

The tool-driving has been carried out principally by the application of a separate motor to each machine, perfect independence of the several units being thus ensured; applied to a large group of iron-working tools is a very interesting multi-voltage system, controlled from a rotary balancer which gives pressures of 50, 75, 125, 150 and 200 volts. By this means a large speed range for such tools as drilling, milling, shaping and slotting machinery is attainable, and it has been found to considerably increase the scope of the various appliances which were originally in use prior to the introduction of electric driving, variable speeding of which could only otherwise be obtained by expensive structural alterations to the machines themselves. All tools recently imported are, of course, designed and properly



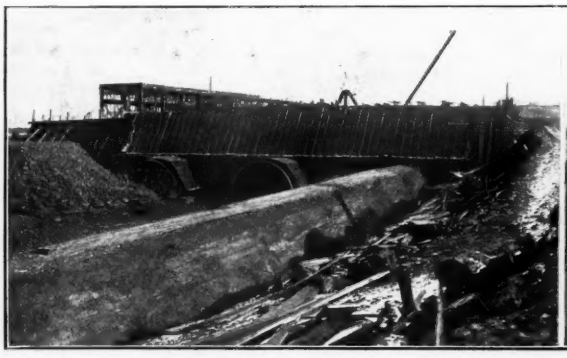
Motor-driven Machine Shop.

equipped for motor drives, suitable provision being made therein for effective speed regulation.

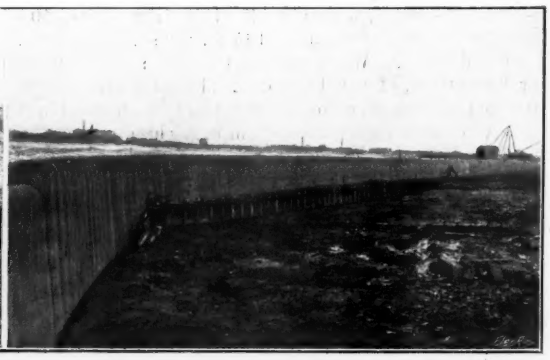
In the engineering, wood-working and other workshops, all the conductors are laid solid in underground trenches, cast-iron junction and inspection boxes dividing up the service into regular sections, for the expeditious localisation of faults, or for extension work. An especially roomy and convenient cast-iron joint box has been introduced by Mr. Mills, for the heavier cable work, much facilitating the jointing and the accessibility of cables for testing purposes.

to be taken up at the old station, removed, set on new foundations, and the switchboard re-erected in its new position and connected with the new mains. The staff employed on this occasion numbered 18 Europeans and 60 natives, under the personal supervision of the chief electrical engineer.

A good view of the station exterior is given on page 229, wherein are seen the spacious proportions of the buildings, as well as what is now the largest brick chimney in the country.



Steel Flume of Ontario Power Co., at Gate-House Site
Flume Covered with Concrete Jacket.



Concrete Curtain Wall of Ontario Power Co.

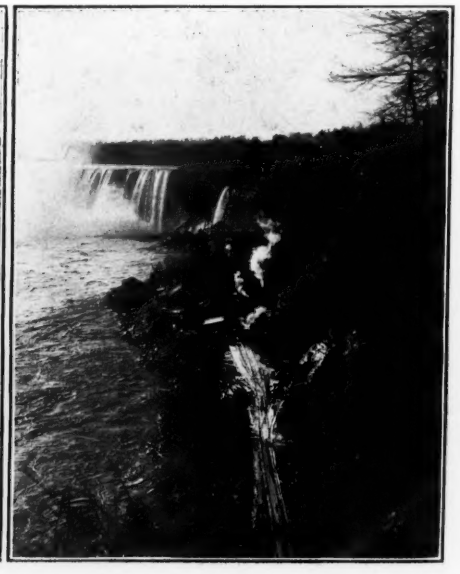
The locomotive erecting shops are served by six 35-ton overhead electric travelling cranes, and two 5-ton quick travellers, while a 5-ton gantry crane is at work in the goods yard for the rapid handling of the heavier class of merchandise in general traffic.

Considerable interest also attaches to the 20-ton electric traverser for transshipment of rolling stock in the carriage repair and paint shops, which takes its supply from overhead trolley lines, and to a couple of motor-driven air compressors of 40 and 100 H.P. respectively. These provide for the large number of pneumatic tools in use in the boiler shops.

Our other illustrations are a general view of the engine room, with pump hold in the foreground; a view taken along the boiler room firing floor, clearly showing the mechanical stoker arrangement; and a bird's-eye view of one of the locomotive machine shops, an important part of what is undoubtedly the finest equipped as well as the most modern and largest engineering establishment in the whole of South Africa.

A view of the saw mill is given, in which can also be seen carriage building bays; in this department are at work the most modern labour-saving wood-working tools, driven

18-ft. Steel Flume of Ontario Power Co.



Site of Power Station in the Gorge,
Canadian Side.

A problem with which the electrical staff was confronted, was the imperative need that the change-over from the old to the new stations and systems should be completed between two ordinary working days, so that no interruption of either light or power supply should occur. It is pleasing to record that the department was quite equal to the occasion, and that the operation, which was commenced after midnight on Sunday, July 23rd, 1904, was so successfully completed, that by the evening of the same day, No. 1 steam-dynamo took up its regular load. This performance is the more creditable, inasmuch as a large motor-generator and its switchboard had

by motors of 220 H.P., and served by four 5-ton overhead electrically driven travelling cranes.

The most important of the up-country stations is situated at Pietermaritzburg, the seat of the Colonial Government. It was built and equipped at a cost of £2,100, and is the centre of a high-pressure three-phase transmission scheme, feeding four outlying sub-stations.

In the generating station are installed two 80-KW. and one 150-KW. alternators, supplying current at 2,200 volts, 60 cycles; these are direct-coupled to "Peache" high-speed single-acting engines, while four "Economic" boilers

supply steam at 140 lb. per sq. in. This station is under the control of Mr. T. P. Pask, A.M.I.E.E., assistant electrical engineer.

The management is to be congratulated on the wisdom of its solution of the problem presented to it when the question of considerably enlarging the works came up in 1902. It then became necessary to commit the department to a definite policy of either steam or electric power supply, in view of the new machinery to be placed on order, as well as the design of buildings to be erected, both of which depended on the future practice decided upon.

The decision of the general manager, Sir David Hunter, K.C.M.G., was that the extensions and future policy of the department should be laid down on the lines of the latest engineering practice, and the wisdom of this course has been abundantly proved by the largely increased output from all departments, in addition to the gain in efficiency accruing from well lighted and ventilated shops, which, as our illustrations show, compare favourably with any we remember to have seen in our English industrial centres.

In conclusion, we have to thank Mr. F. W. Mills, the electrical engineer, for his courtesy in allowing our representative to view the works, and for the excellent photographs and information which he readily supplied.

ELECTRICAL DEVELOPMENT AT NIAGARA FALLS, CANADA.

By ORRIN E. DUNLAP.

THERE are three power projects under way in Queen Victoria Park, on the Canadian side of the river at Niagara Falls, the combined output capacity of which is to be 415,000 E.H.P. Of this stupendous amount, the Ontario Power Co. proposes to develop 180,000 H.P., which is the largest amount of power yet contemplated for any single installation at Niagara Falls, and is within 25,000 H.P. of the total output of the two great power houses of the Niagara Falls Power Co. on the New York side at Niagara.

In the development of the Ontario Power Co., there are features quite new in the Niagara region, and none of the work done in developing power there has been more interesting than that of this company. The Ontario Power Co. was the second to select its site and method of development on the Canadian side, and its plan at the start called for the diversion of the waters about Dufferin Islands in order that the forebays might be constructed at the point selected. To accomplish this huge wing dams were constructed, and a vast area of the riverbed was exposed.

The company's designs provided for the construction of an outer and an inner forebay above the Dufferin Islands, the point being about a mile above old Table Rock. From the inner forebay it is intended to run three steel flumes to Table Rock, where the water of the flumes will empty into an open relief or spillway; from this it will be carried through penstocks to the turbines located in the power station at the water's edge, in the gorge, very close to the foot of the Horseshoe Fall.

To develop the 180,000 H.P. contemplated, the Ontario Power Co. will divert about 12,000 cb. ft. of water every second from the river, above the Horseshoe or Canadian Fall. This diversion will be made at a point where the upper rapids begin. In passing from the main stream to the outer forebay, the diverted water will meet an ice fender or curtain, which is expected to prevent much of the ice that flows down the upper Niagara from Lake Erie in wintertime from entering the forebay. The curtain will drop to within a few feet of the riverbed, and it is expected that the powerful currents of the locality will sweep the ice from the face of the curtain. The depth of water at the intake will be about 18 ft. The area of the outer forebay is about eight acres, while that of the inner forebay is about two acres, making 10 acres in both forebays, all of which covers the normal riverbed, a considerable amount of which was blasted away in order that a sufficient depth of water might be obtained. In the construction of the forebays, piers and various foundations, a vast amount of concrete work was done.

At times of high water, the river wall of the outer forebay will act as a spillway. At the lower end of the outer forebay, the walls are connected by a screen house 320 ft. long, while at the lower end of the inner forebay the gatehouse is located, and is 120 ft. in length. The water will be about 20 ft. deep at the screenhouse, and 30 ft. deep at the gatehouse. Should any ice or *débris* reach the gatehouse section of the inner forebay, it will be discharged through an ice run 5 ft. wide.

The three steel flumes will tap the water supply at the gate-house, the flow being regulated by steel gates. One of the flumes has already been laid. It is made of steel plates ½ in. thick, strongly riveted, and has an inside diameter of 18 ft. Every 4 ft. the plates are strengthened by 8-in. steel deck beams riveted to the upper section. In order that the presence of the big steel pipe might not mar the scenic features of the park, the commissioners of Victoria Park directed that it be laid in a trench excavated for its entire length of over 6,000 ft. Previous to being covered by earth, a conductor was laid to carry off any electric currents that might cause electrolysis, and the upper surface of the flume was sheathed with concrete in order that any unequal earth pressure might be distributed. Some views of the work in different stages are given on the opposite page.

Each 18-ft. flume is expected to supply about 4,000 cb. ft. of water per second, and this water will be caught up in eight penstocks and carried to the station, making 24 penstocks in all that will pass from the top of the bank in tunnels excavated through the high bank, in order that they may not be in view of sightseers on either side of the river, to the power house. Six of the penstocks connecting with each flume will be 9 ft. in diameter, while the two others will each have a diameter of 30 in. The large penstocks will supply the turbines of the generator sets, and the small penstocks will supply the wheels of the exciters. At the power house the 9-ft. penstocks bifurcate, so as to supply water to the twin turbines that will be used. These turbines will make about 187 r.p.m., and will be direct connected to generators of 10,000 H.P. capacity. Tail-races under the power house carry the discharge water from the turbines to the lower river.

The generators will deliver three-phase current, at 25 cycles and 12,000 volts. They will be controlled by apparatus installed in a transforming and distributing station located on the bluff behind Victoria Park, 255 ft. above the power station, and over 500 ft. from it horizontally. It is provided in the agreement made with the Park Commissioners that all the power must be used outside the park limits, but if there is demand for it, one-half of the product of the station must be delivered to Canadian consumers. The Ontario Power Co. has made a contract with the Niagara, Lockport and Ontario Power Co., whereby it is to deliver 30,000 electrical horse-power at the international boundary line at or near the Niagara whirlpool by July 1st, 1905, and an additional 30,000 electrical horse-power at the same point by January 1st, 1907. This contract extends to April 1st, 1950, and may be extended 60 years longer, or to 2010. On its part, the Niagara, Lockport and Ontario Power Co. is to erect a transformer station on the American side of the river, and it is to construct a transmission line as far east as Rochester, N.Y., by July 1st, 1905. From this, one is led to believe that a portion of the product of the Ontario Power Co. will be transmitted to Lockport, Medina, Albion and other places in Western New York.

For its rights in Victoria Park, the Ontario Power Co. pays an annual rental of $30,000 a year, and, in addition, will pay at the rate of $1 per H.P. for all power sold above 20,000 up to 30,000 H.P.; 75 cents per H.P. for all above 30,000 up to 40,000, and 50 cents per H.P. for all sold or disposed of above 40,000 H.P.

The engineers of the Ontario Power Co. are Messrs. P. N. Nunn and L. L. Nunn, while the resident manager is Mr. Banker R. Paine.

NEW LOW-TENSION IGNITION DEVICES FOR PETROL MOTOR-CARS.

THE Simplex ignition device for petrol motor-cars, described in a recent issue of the REVIEW, appears to have been the fore-runner of a number of devices working on a similar principle. At the recent motor-car exhibition in Paris two variations of the system were exhibited, on which we are now able to give illustrations. Fig. 1 gives a sectional view of the Caron device, introduced by La Société Industrielle des Telephones, of Paris, from which it will be seen that it is an exceedingly compact arrangement, the whole apparatus not being much larger than an ordinary sparking plug, whose place it takes in the combustion chamber of the motor. As in the Simplex arrangement, the rod C by which the internal break is obtained, has a to-and-fro motion. When the circuit is closed at the contact maker on the half-time shaft of the motor, an electrical current flows through the coil A, magnetising the soft iron core; the latter in turn draws up the rod C, from the point D, and a huge spark, due to the extra current, takes place when the rupture is made. A light spring around the rod returns the latter to its normal position, resting on D, when the external contact is broken. The only part subject to wear is the point D, which, as in other devices of the kind, can be renewed at a small cost, the renewal only being necessary after several thousand miles of running. Each cylinder is provided with its own combined magnet

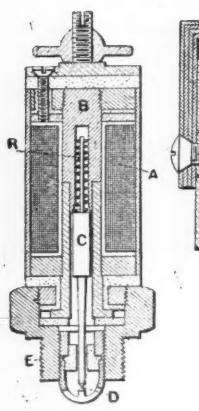


FIG. 1.—CARON IGNITION PLUG.

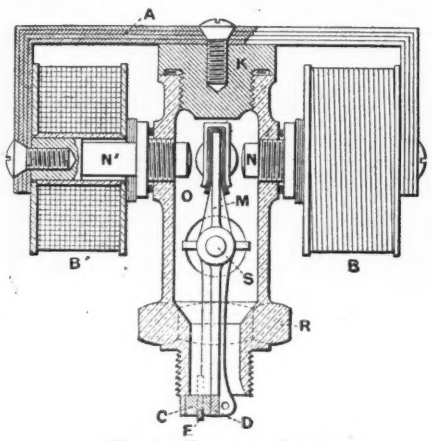


FIG. 2.—ZUBALOFF IGNITION DEVICE.

and plug, and while it will work equally well with accumulators and a contact breaker of the usual type, the Société des Telephones prefer to use a special low tension magneto driven off the half-time shaft to furnish the primary current. The magneto is of the four-pole type, and has a rotatable armature; it furnishes two impulses of current at each revolution of the crankshaft, the current being sent by a distributor to the terminals of a collector, which are directly connected to the plug-magnets, the number of terminals corresponding to the number of cylinders of the engine.

The Zubalof arrangement is being introduced by M. Beaupied, of Paris. The apparatus is so arranged that it can be fitted in place of the ordinary high-tension sparking plug. Referring to the sectional view (fig. 2), it will be seen that the central rod of the plug, by means of which the internal break in the electrical circuit is effected, has an oscillating movement. The rod or lever is supported at its centre of gravity on a spindle S, from which it is insulated by means of mica. The lower end D, of the rod carries a hammer fixed to it by means of a pin. The hammer, rod, and spindle are of nickel, while the end of the rod is mica insulated. The electrical current, which may be furnished either by an accumulator-dynamo, or magneto, is divided into two portions. When the external break in the circuit is closed, that is to say, when contact is made by the contact maker on the half-time shaft of the engine, the current flows through the coil, B; at this moment the hammer D, or rather, the lever M, is attracted towards N, and, turning on its spindle, causes the hammer D to make contact with the block C. This done, the coil B^1 in turn becomes magnetised, as a part of the current from the battery passes through the coil B^1, the lever, hammer, and block, which are in series with it. The engine continuing to run, the external contact on the half-time shaft is broken, the blade being on the insulated portion, and current ceases to flow in B. The coil B^1 only is now magnetised, and attracts, in turn, the lever M, causing the hammer D to leave the block C suddenly, a large spark due to the extra current taking place between the two parts. The contact maker on the engine can, of course, be advanced and retarded in the usual way. The apparatus is strongly made, and will work in any position, a special claim being made that its regular action does not depend in any way on springs. The only parts subject to wear are the hammer D, and the block C; these will, however, last for several thousand miles, and are so attached that they may readily be renewed. The device is adaptable to single or multi-cylinder engines, each cylinder being fitted with its own magnets and plug wired up to the usual contact maker.

THE ELECTRICAL VOLUNTEERS.

THE following orders are announced for next week:—

Monday, February 13.—"A" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture and demonstration on the Potentiometer, by Mr S. W. Melsom, 9 p.m.

Tuesday, February 14.—"B" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Medical inspection for recruits and Special Service Section, 7 p.m.

Wednesday, February 15.—Instructional drill, headquarters, 8 p.m.; plain clothes; rifles without slings. Submarine mining class, 6—9 p.m. Examination "C" and "D" Companies for "A" badge, 7 p.m.

Thursday, February 16.—"C" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture by Capt. Phillips on "Special Points on Working of Steam Engine," 8.30 p.m.

Friday, February 17.—"D" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Bohemian Concert at "The Horns" Assembly Rooms, Kennington Road, 8 p.m.

Saturday, February 18.—Week-end class.

J. H. S. PHILLIPS, Captain,
For O.C.E.E.R.E. (V.)

NOTES.

Canadian Niagara.—Mr. Orrin E. Dunlap writes:—"The Canadian Niagara Power Co. started the first two 10,000-H.P. units in its new station in Victoria Park, on the Canadian side at Niagara Falls, on the morning of Monday, January 2nd. At 11.30 o'clock President William H. Beatty moved the small wheel that governed the flow of water on Turbine No. 1. The unit responded instantly, and the first of the big 10,000 H.P. generators started to revolve. Gradually its speed was increased until it was making 250 revolutions a minute, and then the second unit was successfully started. In thus starting its great plant, the Canadian Niagara Power Co. fulfils its agreement with the Canadian Government, its contract calling for a development by January 1st, 1905, involving the construction of a tunnel with a capacity for the discharge of water sufficient to produce 100,000 H.P., a canal or intake from the river with a capacity of 50,000 H.P., a wheel-pit with a capacity of 50,000 H.P., and 20,000 electrical H.P. ready for use, sale or transmission. But the works have been constructed on a larger scale than called for in the agreement, so that the company has a canal, tunnel and wheel-pit complete, for the development of 110,000 H.P. The power house is well forward, and a total of five units will be installed and ready for operation by May 1st. In the wheel-pit and station there will be room for six additional turbines and generators of the same size, and these can be quickly installed as the demand requires their installation.

The turbines were designed and manufactured by Escher, Wyss and Co., of Zurich, Switzerland, while the generators were made by the General Electric Co., of Schenectady. The water is led to the turbines from the canal by penstocks 10 ft. in diameter, and after driving the wheels is discharged through a tunnel 2,200 ft. long, at a point in the gorge close to the foot of the Horseshoe Fall.

The Canadian Niagara Power Co. is owned by the Niagara Falls Power Co., whose power houses on the New York side contain installations of 105,000 H.P. capacity. The power house of the Canadian Niagara Power Co. is connected with these two power houses on the New York side by cables laid in conduits through the Canadian Park and City of Niagara Falls, crossing the river on the upper steel arch bridge. It is possible to operate the three big stations as one plant, and thus every power customer of these two companies, whether he be on the American or Canadian side, has the assurance of continuity of a supply of power given by these connections. This international development under a single direction may be expeditiously enlarged from its present output by the installation simply of the additional units of machinery for which the Canadian works are prepared. It may be still further enlarged by the exercise on the part of the Niagara Falls Power Co. of its already acquired right to a further development of an additional 100,000 H.P. by means of another tunnel.

Liverpool Tramways.—The returns of the Liverpool tramways for 1904 show that the mileage travelled was 12,166,419; the number of passengers carried, 116,642,663; the receipts, £540,916; the increase over 1903, £16,407. The percentage increases in 1904 over 1093 were:—Mileage, 3·68 per cent.; passengers, 3·17; receipts, 3·13. Compared with 1897, the last year under the old company's control, the percentage increases in 1904 were:—Mileage, 102·33 per cent.; passengers, 203·68; receipts, 86·05 per cent.

Junior Institution of Engineers.—On Friday last Prof. H. T. Davidge read a paper before this Institution on "Recent Developments in Electric Lighting." First discussing the general conditions of the problem of electrical illumination, and the criteria by which the quality of a lamp is determined, the author gave an outline of the history of the art, and classified the various types of electric lamp now extant, under nine heads. He then described the principal types of arc lamps, and compared their efficiencies. Dealing with carbon glow lamps, he emphasised the importance of regularity of pressure, enabling high efficiency lamps to be used. Lamps with filaments consisting of compounds of carbon were briefly mentioned, and arcs between electrodes other than carbon. Osmium and tantalum filaments were also described, followed by the Nernst, in connection with which the author remarked that vacuum was not necessary, but omitted to point out that the access of air to the

glower was essential. Cooper-Hewitt and Bastian mercury vapour lamps were next dealt with, and these, besides some other lamps, were shown in operation. Cathode bombardment lamps, high frequency effects, and special forms of electric lamps, such as the Finsen light, received brief notice, and the firefly's modest but efficient radiations were held up for emulation.

Conductivity of Calcium. — MM. Moissan and Chavanne (*Comptes Rendus*, January 16th) give the electric conductivity of calcium prepared by the industrial process of the Bitterfeld Works. Wires of the homogeneous metal were measured by a Wheatstone bridge. To prevent action of the air they were covered with petroleum. The conductivity of silver being taken as 100, that of calcium is 15·6 at 20° C. Mathiessen gave it as 22 at 17° C.

Rabbit Stops an Electric Train.—A singular incident occurred on Friday last close to Formby railway station on the electric railway. An electric baggage car was proceeding between Southport and Liverpool, when the electric current was suddenly cut off, and the car came to a complete standstill. It was found that a rabbit had been caught by the collector which receives the electricity from the "live" rail, and the animal had become wedged between the line and the collector, which effectually cut off the electric current. The electrocuted rabbit was removed as quickly as possible, and the car resumed its journey.

Petrol Motor-Cars.—A very valuable paper on this subject was read before the North-East Coast Institution of Engineers and Shipbuilders at Newcastle, on 20th ult., by Mr. Frank Little. The paper was very fully illustrated, and dealt with every part of a motor-car in great detail. The only part of direct electrical interest is, of course, the ignition device, and this was as fully treated as any other item. The author did not confine himself to any one type, but compared the best makes of the various parts, as well as the different systems of driving, steering, braking, &c.

The Origin of Radium.—In a letter to *Nature* of January 26th, Mr. Frederick Soddy refers to experiments made to test the view of Prof. Rutherford and himself, that radium was a product of the radio-active change of uranium, the result of which last year appeared to be negative. Resuming the research in the new chemical laboratories of Glasgow University, into which no radium had been brought, Mr. Soddy now finds that his earlier result was affected by an error; he is satisfied that there is a steady production of radium from uranium, though it appears to take place at $\frac{1}{300}$th of the theoretical rate. The error previously made was due to the existence of radium emanation in the laboratory, and it seems that, to ensure accuracy in prosecuting experiments of such extreme delicacy as these, it is necessary to use entirely new apparatus at every stage of the processes. It is suggested that the low rate of production found may be due to a large part of the emanation being retained by the uranium solution, and further experiments are now in progress to decide this point.

In the issue of *Nature* for February 2nd, Mr. W. C. D. Whetham corroborates Mr. Soddy's statement, having himself observed that the quantity of radium emanation now evolved by his uranium salt is distinctly greater than at first.

Royal Society.—The following papers were down for reading on February 9th:—

Prof. J. A. Fleming, F.R.S., "On the Conversion of Electric Oscillations into Continuous Currents by means of a Vacuum Valve," and "On an Instrument for the Measurement of the Length of Long Electric Waves, and also Small Inductances and Capacities."

Capt. A. M. Field, R.N., "Report on an Area of Local Magnetic Disturbance in East Loch Roag, Lewes, Hebrides." Communicated by Rear-Admiral Sir William Wharton, K.C.B., F.R.S.

G. T. Beilby, "Phosphorescence caused by the Beta and Gamma Rays of Radium." Communicated by Prof. J. Larmor.

Sir William Crookes, F.R.S., "Europium and its Ultra-Violet Spectrum."

Papers and Lectures.—On 1st inst. the Right Rev. Monsignor Molloy delivered, in the Theatre of the Royal Dublin Society, a lecture on "Electrical Resonance and its Application to Wireless Telegraphy."

At a meeting of the Society of Architects to be held at Staple Inn Buildings, Holborn, London, E.C., on the 16th inst., Mr. B. R. Tucker will read a paper on "The Lighting of Buildings by Electricity and Incandescent Gas."

Dr. E. W. Marchant, Professor of Electrical Engineering in the University of Liverpool, lectured on "The Electric Current and its Applications," on January 31st, in the Picton Lecture Hall.

Institution Notes.—The second annual dinner of the Leeds Local Section of the Institution of Electrical Engineers is to be held at the Hotel Metropole, Leeds, on Friday, March 3rd. The chair will be taken by Mr. W. Emmott, A.M.I.C.E., M.I.E.E., president of the Section, supported by the Lord Mayor of Leeds; Mr. A. Siemens, president of the Institution; Mr. G. C. Lloyd, secretary of the Institution; the chairman of other local sections, and other eminent members of the profession. The hon. secretary is Mr. G. R. Blackburn, tramways department, 15, Bridge Street, Bradford.

The members of the I.E.E. (Glasgow Section) held a very successful Smoking Concert in the Grosvenor Restaurant, on Saturday evening, the 4th inst.

Gas Explosion.—An explosion of gas occurred at the High Level Station of the London and North-Western Railway, Wolverhampton, a few days ago in one of the waiting-rooms. Three men were injured. It is supposed that a gas-pipe beneath the floor had leaked.

American Enterprise in Canada. — The Montreal correspondent of the *Nottingham Daily Guardian* says that an American firm has secured the contract for the construction of an electric street railway in Montreal. "The Americans offered to do the work considerably cheaper than it could be undertaken by local contractors."

Appointments Vacant.—Electric tramway staff for Walthamstow; assistant electrical engineer (£104) for Whitby; shift engineer for Southend-on-Sea (42*s.*); switchboard superintendent for Glasgow Telephone Department.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—Mr. W. R. NICE, late meter assistant to the Lancaster Corporation, has been appointed to a similar position at Hammersmith. There were 64 applicants for the position.

Out of over 150 applicants for the post of assistant electrical engineer at the Bradford Electricity Works, the following have been selected to attend before the Electricity Committee:—Mr. Chas. W. Salt, Croydon; Mr. J. R. Blaikie, Streatham; Mr. T. H. Birrell, Worcester; and Mr. R. M. Torpy, Wimbledon. The salary is £250 a year.

The Dover T.C. has appointed Mr. C. H. LYDALL to succeed Mr. T. McGill as station superintendent at the Electricity Works, at a salary of £150 a year, rising by annual increments of £25 to £200.

The recommendation of the E.L. Committee of Wakefield T.C. to appoint Mr. H. A. Nevill, first assistant electrical engineer, as city electrical engineer at a salary of £300 a year, rising by £25 per annum to £400, has been referred back to the Committee.

The St. Helens T.C. has granted increases of salaries to:—Mr. F. DICKINSON, works superintendent; Mr. C. WHITE, mains superintendent; Mr. J. W. WARR, traction and motor superintendent; Mr. R. M. MAINE, station engineer; Mr. R. ROBY, shift engineer; Mr. J. CROSTON, shift engineer.

The Electricity Committee of Warrington T.C. has granted the following increases of salary to officials:—Mr. F. V. L. MATHIAS, electrical engineer, from £250 to £300 per annum; Mr. F. W. PURSE, assistant electrical engineer, from £156 to £169; Mr. J. TELFER, tramways manager, from £120 to £140; Mr. W. E. ROGERS, mains engineer, from £130 to £143.

The Dewsbury Electricity Committee has recommended the T.C. to increase the salary of Mr. A. P. Dryburgh, assistant engineer at the Electricity Works, from £150 to £170 per annum.

Mr. J. E. DONOGHUE, late resident engineer in Melbourne to the Electric Lighting and Traction Co. of Australia, has recently been appointed chief assistant engineer in the Sydney Municipal Electricity Works under Mr. Thomas Rorke. Mr. Donoghue was formerly with Messrs. Glover & Co., of Old Trafford, Manchester.

Tramway Officials.—The Joint Electricity and Tramways Committee of Southampton T.C. has recommended that the borough electrical engineer, Mr. STREET, should be appointed manager of the electric tramways for 12 months in addition to carrying on his present duties, at a salary of £650 per annum.

Mr. FREDERICK COUTTS has been appointed from Ayr to Paisley as manager of the tramway system at a salary of £400 per annum. Mr. Coutts went to Ayr from Dundee when the tramway system was inaugurated in 1901.

Mr. T. B. HOLLIDAY has resigned the position of engineer and manager of the Brighton Municipal Tramways in order to become engineer and manager of the Hastings and District Tramways Co.

Mr. W. RELPH, of the Stalybridge, Hyde, Mossley and Dukinfield Tramways, has been appointed tramway superintendent to the Leith Corporation Tramways.

General.—Mr. MARCONI is to be a guest of the New Vagabond Club at the Hotel Cecil on 27th inst. Mr. Henniker Heaton, M.P., will preside.

Mr. NICOLAS LAMPRINOPOULOS has been appointed Director-General of Posts and Telegraphs of Greece.

Mr. E. KILBURN SCOTT has left for Sydney to take up his new appointment. He has gone by the ss. *Scharnhorst*, which was to leave Genoa on 7th inst.

The Society of Engineers on Monday, through its president, Mr. D. B. Butler, presented the President's Gold Medal to Mr. WILLIAM EDWARD STOREY for his paper on "Condensing Machinery"; and a Society's Premium of Books to Mr. A. S. E. ACKERMANN for his paper on "British and American Coal-cutting Machines."

Obituary.—We regret to record the death, after a brief illness, of Mr. JAMES EDWARD RANSOME, chairman of Ransomes, Sims & Jefferies, Ltd., of Orwell Works, Ipswich, which occurred on January 30th. The interment took place at Ipswich Cemetery on 3rd inst.

Mr. THOMAS EDWARD BRYERS, vice-chairman of the Sunderland Corporation Tramways Committee, died on Friday last from the effects of a fall over a cliff near Aysgarth, Wensleydale. Ten of the jurymen thought, with the coroner, that the evidence pointed to suicide, but as there were two who thought the evidence insufficient, an open verdict was returned.

NEW COMPANIES REGISTERED.

British Electric Co., Ltd. (83,338).—This company was registered on January 24th, with a capital of £2,000 in £1 shares, to acquire from J. C. Dear, of 8, Mortimer Street, Cavendish Square, W., the benefit of a certain existing invention relating to improvements in holders for electric incandescent lamps, to adopt an agreement with the said vendor, and to carry on the business of manufacturers of and dealers in electrical and gas fittings, installers of electric light and gas, &c. The first subscribers are:—C. E. Best, 40, Chancery Lane, W.C., solicitor, with 20 shares; A. D. G. Robertson, 20, High Holborn, W.C., insurance broker, with one share; R. Perry, 2, Queen's Square Place, W.C., electrical engineer, with one share; N. Vickery, Blair Athole, Cranes Park, Surbiton, gentleman, with 150 shares; H. E. Robertson, 17, Hindes Road, Harrow, gentleman, with one share; E. C. Morris, 4, Hemberton Road, Clapham, clerk, with one share; and P. A. Connew, The Mead, Orpington, surveyor, with one share. No initial public issue. The first directors are N. Vickery (managing director), J. C. Dear and C. E. Best; qualification, £20. Registered office, 8, Mortimer Street, Berners Street, W.

Bohm Lens Lamp Co., Ltd. (83,466).—This company was registered on February 3rd, with a capital of £4,000 in £1 shares (200 deferred), to acquire the business carried on at 104 and 105, Great Russell Street, W.C., as Bohm Lens Lamp Co., to adopt an agreement with F. J. Pullen and E. C. Funnell, and to carry on the business of lamp manufacturers, glass blowers, electricians, suppliers of electricity for light, heat, motive power or other purposes, engineers, &c. The first subscribers (each with one share) are:—F. J. Pullen, 104, Great Russell Street, Bloomsbury, W.C., accountant; E. C. Funnell, 104, Great Russell Street, Bloomsbury, W.C., accountant; F. Heywood, 132, Walm Lane, N.W., wine merchant; F. C. Funnell, 19, Baldry Gardens, Streatham, S.W., incorporated accountant; S. W. Coathupe, 20, Almeida Street, Islington, N., clerk; C. G. Beresford, 14, Milman Road, Queen's Park, W., clerk; and T. H. Smythers, 34, Homefield Road, Chiswick, W., clerk. No initial public issue. The number of directors is not to be less than two nor more than six: the first are F. J. Pullen (chairman), E. C. Funnell, F. Heywood and E. Bohm; qualification, 200 shares; remuneration, £100 per annum, divisible. Registered office, 104, Great Russell Street, Bloomsbury, W.C.

Lowden Electric Lamp Co., Ltd. (83,470).—This company was registered on February 3rd, with a capital of £3,000 in £1 shares, to acquire and take over as a going concern the business carried on at Watford, Herts., as the Lowden Electric Lamp Works. The first subscribers (each with one share) are:—W. R. Keene, 6, Stone Buildings, Lincoln's Inn, W.C., gentleman; Capt. H. M. A. Hales, Askham, Hythe, Kent (Bedfordshire Regiment); S. I. Pellet, 3, Warsham Grove, Clapham Common, S.W.; L. E. Filmore, Granville House, Arundel Street, Strand, W.C., secretary; H. A. Solway, 13, Colville Square, Bayswater, W., secretary; T. W. Lowden, 75, Goldsmith Avenue, Acton, W., electrical engineer; P. F. D. Brockman, Effingham House, Arundel Street, W.C., chairman Monitor and Ajax Traction, Ltd. No initial public issue. Registered without articles of association. Registered office, Granville House, Arundel Street, Strand, W.C.

Durham Collieries Electric Power Co., Ltd. (83,421).—This company was registered on January 31st, with a capital of £125,000 in £1 shares (100,000 6 per cent. cumulative preference), to adopt (1) an agreement dated January 30th, 1905, between the Sunderland Electric Tramways, Ltd., of the one part, and a trustee for the company of the other part, providing (*inter alia*) the supply of electricity by the company to the Sunderland District Electric Tramways, Ltd., at a fixed rate, and for subscribing for shares and debentures in the last-named company; (2) an agreement dated January 27th, 1905, between the Electric Conversion Syndicate, Ltd., of the one part, and a trustee for this company of the other part, for the acquisition by this company of certain rights to land at Philadelphia, Durham, and for the rendering of certain services by the said syndicate; (3) a contract dated December 23rd, 1904, between D. Balfour, jun. (for this company) of the one part, and the Lambton Collieries, Ltd., of the other, for the supply of electric power to the Lambton Collieries; and (4) a contract dated January 24th, 1905, between the said D. Balfour, jun. (for this company) of the other part, and the Hetton Coal Co., Ltd., of the other part, and to carry on the business of suppliers of electricity for light, heat, power or otherpurposes to any persons or public or private bodies, electrical and mechanical engineers, producers, accumulators and storers of electricity and gas, &c. The first subscribers are:—J. S. Bergheim, Belsize Court, Belsize Park, N.W., gentleman, 5,000 shares; H. R. Hogg, 6, Clanricarde Gardens, W., chairman of Electric Conversion Syndicate, Ltd., 250 shares; W. Buchanan, 84A, Ormiston Road, Shepherd's Bush, W., engineer's draughtsman, 1 share; W. Weil, 85, South Side, Clapham Common, S.W., engineer's assistant, 1 share; F. W. Moore, 13, St. Helens Place, E.C., secretary, 1 share; E. G. Nisbit, 23, Austin Friars, E.C., solicitor, 1 share; and W. H. Priestley, 22, Wontner Road, Balham, S.W., secretary, 1 share. Minimum cash subscription on original issue, 85,000 shares; on any future issue, 20 per cent. of the shares offered. Borrowing powers limited to £200,000 (maximum without consent of preference shareholders, £50 000). The directors may in addition effect temporary loans not exceeding £20,000, exclusive of any part outstanding on debentures. The number of directors is not to be less than three nor more than seven; the first are Sir Douglas Fox, 28, Victoria Street, S.W., H. S. Bergheim and H. R. Hogg; qualification, £240; remuneration, £225 per annum for the chairman, and £150 each for the others, with 10 per cent. of the profits distributed in excess of the dividend on the preference shares, divisible.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Cape Electric Tramways, Ltd. (54,636).—This company's annual return was filed on December 16th, when 491,222 shares had been taken up out of a nominal capital of £500,000 in £1 shares. £91,222 has been paid, and £400,000 is considered as paid. Mortgages and charges: Nil.

British Electric Light Wiring Co., Ltd. (58,013).—This company's annual return was filed on December 24th, when 156 shares had been taken up out of a nominal capital of £10,000 in £1 shares. £1 per share has been called up on 149, and 10s. per share on seven shares, resulting in the receipt of £162 10s. Mortgages and charges: Nil.

Marconi International Marine Communication Co., Ltd. (65,759).—This company's annual return was filed on January 5th, when 204,056 shares had been taken up out of a nominal capital of £350,000 in £1 shares. 17s. 6d. per share has been called up on 99,056 shares, resulting in the receipt of £86,662 12s. 6d. £11 7s. 6d. remains in arrears. 105,000 shares are considered as fully paid. Mortgages and charges: Nil.

Nicholson & Robinson, Ltd., electricians, Westminster (82,651).—A first charge on the company's undertaking and property, present and future, including uncalled capital, dated January 2nd, 1905, to secure £550, has been registered. Holder: F. B. Nicholson, 93, Gunterstone Road, West Kensington, W.

Electrolytic Alkali Co., Ltd. (64,360).—This company's annual return was filed on December 16th, when 100,000 preference and 202,818 ordinary shares had been taken up out of a nominal capital of £500,000 in 200,000 preference and 300,000 ordinary shares of £1 each. £1 per share has been called up on 100,000 preference and 127,218 ordinary, and £226,997 has been received, leaving £231 in arrears. 75,000 ordinary shares are considered as fully paid. Mortgages and charges: £12,750.

Willey & Co., Ltd., gas and electrical engineers, Exeter and London (79,618).—Particulars of a series of £20,000 debentures, created by resolution of August 8th, 1904, and covered by trust deed dated December 29th, 1904 (registered January 5th, 1905), have been filed pursuant to Section 14 (4) of the Companies' Act, 1900. The debentures are issued by virtue of Article 116, subject to an agreement dated August 8th, 1904, with G. W. Durant, which was confirmed by resolution of preference shareholders on same date. Property charged: The company's undertaking and property, present and future, including uncalled and unpaid capital. Trustees: W. Cash, 90, Cannon Street, E.C.; and E. Herbert, 6, Finch Lane, E.C.

Porous Accumulator Co., Ltd. (57,526).—This company's annual return was filed on December 28th, when the entire capital of £3,000 in 3,000 shares of £1 each had been taken up. £1,007 has been received. £1,993 is considered as paid. Mortgages and charges: £16,000.

Electrical Bleaching Co. (1904), Ltd. (81,614).—Issue on January 18th of £12,000 6 per cent. debentures, part of series created December 21st, 1904, to secure £14,000. Property charged: The company's undertaking and property, present and future, except uncalled capital. No trust deed, but the title deeds of the company's property are to be deposited in the joint names of a nominee of the board and a nominee of the debenture holders, with a safe deposit company or bank. The present nominees are F. R. B. Lindsell, 31, Dickinson Street, Manchester (board), and J. H. Haynes, The Limes, Leigh, Lancs. (debenture holders). No previous issue of same series.

Sherard Cowper-Coles & Co., Ltd. (67,136).—This company's annual return was filed on January 13th, when 6,856 preference and 18,000 ordinary shares had been taken up out of a nominal capital of £25,000 in 7,000 preference and 18,000 ordinary shares of £1 each; £1 per share has been called up on 6,856 preference and 500 ordinary, and £7,356 has been received; 17,500 ordinary shares considered as fully paid. Debentures: £6,500.

Northampton Electric Light and Power Co., Ltd. (28,640).—Issue on January 5th of £500 and on January 20th of £100 debentures, part of series created June 3rd, 1896, to secure not more than two-thirds of the company's subscribed and paid-up capital, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £32,600.

C. & A. Musker (1901), Ltd., mechanical and electrical engineers, Liverpool (70,573).—Issue on January 20th of £4,000 debentures, part of series created July 5th, 1901, to secure £50,000, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: Law Guarantee and Trust Society, Ltd., 49, Chancery Lane, W.C. Previously issued of same series: £40,000.

Electrical Corporation, Ltd. (62,630).—This company's annual return was filed on December 23rd, when 3,007 shares had been taken up and paid for in full out of a nominal capital of £30,000 in £1 shares. Mortgages and charges: nil.

ELECTRICITY SUPPLY ACCOUNTS.

St. Pancras Municipal Electricity Supply.

Some 12 months ago we referred in these columns to the healthy state of the St. Pancras undertaking, and our remarks on that occasion apply equally to the present time. The output increased during the year by some half a million units, and the gross profit mounted up from £32,000 to £40,000. After meeting all working and financial charges, the department had a balance in hand of over £20,000. The working costs, compared with the previous year, show a reduction in total, and of ½d. per unit on the average.

Judging from the Council's recent decision in regard to cheap day lighting, the future development of the undertaking seems assured. The year's surplus provided an additional £16,000 for reserve, and for the writing off of sundry items of capital account, a balance of £2,320 being carried forward to next year's account.

The prices charged are:—Private lighting, 6d. and 1½d. (maximum demand), 4d. flat, and 1d. per unit, special day lighting rate; power, 1d. per unit. The chief engineer is Mr. Sydney W. Baynes.

General Statement.

For year ending March 31st—	1904.	1903.
Total capital expended	£460,368	£423,500
Number of units sold—		
Private supply	3,820,951	3,310,403
Public lighting	909,390	894,647
Total number of units sold ...	4,730,341	4,205,050
Equivalent No. of 8-c.p. lamps connected	244,438	198,463
Number of motors connected	312	259
Number of public lamps	461 arc	453 arc
Maximum load in kw.	3,193	2,741
Revenue account—		
Gross revenue	£75,774	£68,372
„ expenditure	£35,687	£36,096
„ profit	£40,087	£32,276
Average inclusive price obtained per unit—		
Private supply	3·97d.	4·05d.
Public lighting	3·00d.	3·00d.

Revenue Account for Year ending March 31st, 1904.

Gross revenue	£75,774 = 3·84d. per unit.
Works and distribution costs (including public lighting)	£27,423 = 1·39d. „
Total working costs	£35,686 = 1·82d. „

Profit Statement.

Interest on loans, &c.	£13,093
Sinking fund	6,122
Allowance for bad debts, &c.	288
Balance on year's working	20,584
Gross profit	£40,087

Poplar Municipal Electricity Supply.

The returns of the Poplar electricity department for the year ending March 31st, 1904, are given below. During the period under review, the department supplied 695,502 units for private and 678,840 units for public lighting, and 832,055 units for power. It will be seen that the power and public lighting outputs are together more than double that for private lighting—the power load, particularly, is rapidly developing, having nearly doubled during the year, and should favourably influence the working results in the near future.

On the year's working a gross profit of nearly £11,000 was earned, and on the present basis of financial repayments a balance of nearly £3,000 remained. Allowing for the surplus available from previous years, the department holds a balance of £6,893.

The prices charged are:—Private lighting, 5d. and 3d. (maximum demand) per unit; public lighting and power, 1½d. per unit. The chief engineer is Mr. J. Horace Bowden.

General Statement.

For year ending March 31st—	1904.	1903.
Total capital expended	£194,301	£187,192
Number of units sold—		
Private supply	1,527,557	1,322,447
Public lighting...	678,840	465,100
Total number of units sold ...	2,206,397	1,787,547
Equivalent No. of 8-c.p. lamps connected	79,471	50,375
Number of public lamps	320 arc. / 1,649 inc.	220 arc. / 1,530 inc.
Maximum load in kw.	1,224	912
Revenue Account—		
Gross revenue	£25,458	£22,664
„ expenditure	£14,671	£12,290
„ profit	£10,787	£10,374
Average inclusive price obtained per unit—		
Private supply	3·59d.	3·42d.
Public lighting	3·25d.	3·71d.
Power	1·72d.	1·85d.

Revenue Account for Year ending March 31st, 1904.

Gross revenue	£25,458 = 2·78d.	per unit.
Works and distribution costs (including public lighting)	£11,180 = 1·21d.	„
Total working costs	£14,671 = 1·60d.	„

Profit Statement, 1904.

Interest on loans, &c.	£6,331
Sinking fund	1,463
Bad debts, &c.	8
Balance on year's working carried forward ...	2·985
Gross profit	£10,787

CITY NOTES.

Central London Railway Co.

Sir Henry Oakley, chairman, presided on Wednesday at the Holborn Restaurant over the nineteenth ordinary general meeting of the above company.

In moving the adoption of the report, the Chairman said that the number of proprietors was 2,464, or an increase of 11 during the half-year. There had been no alteration in the stock. The half-year had been uneventful. Happily, they had had no calamity, and no striking success. They had gone on with their daily work uninterrupted, and considering the adverse conditions of the weather and the so-called depression in trade, they could congratulate themselves on having earned a little more money and carried a substantially greater number of passengers. Whatever, therefore, the outside circumstances might be, it did not appear to have affected their traffic. The capital expenditure had only been £12,000, and was spent on a few matters of equipment and the completion of the sub-station at Bond Street. He could speak with no certainty as to future expenditure. They did not know what they might be called upon to expend. Their undertaking was a new one, and the system on which it was worked was being daily developed in many ways more or less important. They were endeavouring to keep their concern up to date, but at this moment they were not contemplating any serious expenditure either in this or the next half-year. They had a balance of unexpended capital of £23,677, and had powers to raise further capital of £278,000, so that so far as capital was concerned, they were under no anxiety. During the half-year they had carried 21,906,150 passengers, and the receipts from all sources were £176,281. The workmen represented £12,000 of their total; they were so-called workmen, which was to say that they were anybody who chose to book before half-past seven in the morning. There was no great influx of workmen from any particular place, but there was a steadily-growing proportion booking in the larger stations on all points of junction. It was supposed at one time that the workmen would come from Shepherd's Bush, which would develop into a workmen's colony, but that did not seem to have been the case, for a large proportion were booked at Tottenham Court Road and Marble Arch, and at every point where the main roads reached their stations. Curiously, many left London to go to Shepherd's Bush, which was probably due to the great building operations in that place, which gave employment to those in the building trade. They were satisfied that they were not going to be flooded by an undue proportion of workmen, for while the number carried was slightly larger, it was not significantly larger. The expenses for the half-year had been reduced by £1,425. They had run less miles and carried more people, and the result was an increase in receipts of £2,471. They had carried 131,000 more people, and run 35,000 less miles. They looked upon that as very satisfactory working on the part of the manager and his staff, for they had gone on year by year increasing the number of people and with some reduction in expense. What was, however, more worth observation was that they had since they started carried 191,239,000 people without injury to one. In the morning and evening the pressure on the line was very great, and they ran 31 trains within the hour, and those who had watched the passage of the trains would, he felt convinced, pay homage to the admirable way in which the work was done. They carried more per train-mile now than formerly. Leaving out the first year, they had increased from 4s. 10d. per mile to 5s. 5d. The expenses were slightly up, but not in anything like the proportion of the additional earnings. In the past year they had issued books of 12 tickets, which had been a great boon to the passengers, and had not cost the company anything as the charge was the same. Altogether they had £140,000 to deal with, which after the payment of a dividend of 4 per cent., left £52,000 unappropriated. Some of their critics said that was too much to be carried forward, but there were two things to be considered. First, they had to meet the expenses incurred in the promotion of their Bill in Parliament, and there was also the question of the replacement of the original engines by the motor engines to prevent vibration. With regard to the first, he felt that they were likely to be successful in their application to Parliament, as they had shown their merits, but the other was a more difficult subject. As they knew, owing to the vibration they had to replace their original engines with motors. These engines were admirably designed, and they were trying both here and in America to dispose of them. It was quite possible that with the development of electric traction on surface lines they would be able to dispose of them, especially as they could be bought relatively cheaply. Under the circumstances, he felt they should wait some time before disposing of these engines as scrap. Dealing with the Bill before Parliament, the chairman said the idea was to run from Shepherd's Bush, Hammersmith, Kensington, Knightsbridge, Piccadilly, Strand, Fleet Street to Farringdon Street. Then to avoid St. Paul's Cathedral they would diverge slightly to the south to Queen Victoria Street, and continue to Leadenhall and turn back to their railway at the Bank, so that they would make one complete circle. They claimed as the merit of their scheme that they would be able to carry people to all parts of London; and they would, of course, have as many interchange stations with other railways as possible. They would be able to work more economically, and he ventured to say would give London the best means of locomotion it could have. They had also agreed with the Great Western Railway for a station and connecting line at Shepherd's Bush, and were arranging for connecting stations with the Charing Cross and Hampstead Railway and the Baker Street and Waterloo Railway.

Viscount Esher seconded the motion.

Replying to questions, the Chairman said that they had removed everything from their stations of an inflammable character. They carried the workmen at a shade of profit.

The report was adopted, and at a subsequent extraordinary meeting a resolution was carried approving of the company's Bill in Parliament.

Metropolitan Electric Supply Co.

An extraordinary general meeting was held at Winchester House on Tuesday, to consider two Bills that the company is promoting this session.

Mr. W. H. Cripps, who presided, said that one was the Various Powers Bill, and the other the Acton Bill. In regard to the first, he explained that, lying to the west of them at Willesden, there was a very considerable area which would include Uxbridge, Drayton and other places. At the present moment electricity in that portion of Middlesex was in its infancy, and was very little developed, and they conceived that, considering that at Willesden the company would very soon have set free a considerable amount of plant which was now supplying Marylebone, it was very desirable that they should, as far as possible, find employment for it. It was not proposed to enter into competition with any of the authorities or companies holding provisional orders there, but to offer them a bulk supply, so that they could supply their own customers cheaper than they could from their own small stations; so that they were not in any sense entering upon a scheme either of rivalry or competition. There was another provision in the Bill to include the north-west corner of Paddington. When the company obtained its original provisional order that was part of the Chelsea district. It had now been transferred to Paddington, and this company could not supply it without Parliamentary authority. There was a Bill registered by the Administrative County of London Co. applying for powers to supply, so far as they could see, the whole of London, practically the whole of Middlesex, and a good deal of Kent and Surrey. The directors felt very strongly that the present London companies, which between them had invested many millions of capital, were not only in a position, but were willing and anxious, to supply every scrap of power required in any of those districts to-morrow—not in the course of two or three years when certain stations could be built. But these companies were under a disadvantage imposed upon them by Parliament, in that they could not without sanction of Parliament help each other. They conceived that as the power supply increased it would be very desirable that they should have

the power to supply into each other's stations, so that the deficiency in one area at one time might be supplied by the excess of power in another. In their Bill they were seeking powers to be able to supply, not to individual consumers in anybody else's area in rivalry, but to existing undertakers with their wish and sanction. The Bill contained another provision. They were in rather a curious position. They were able at present to supply any railway company, any tramway company, or any canal that ran through their district, but the moment the railway train, tramcar, or barge got outside their district, it was doubtful, according to a recent decision of the Court of Chancery, whether they could really supply. The restriction was palpably absurd. The directors wanted to make it perfectly clear that they might supply these railways, &c., passing through their area, and that when the latter had got the supply they might do just as they liked with it. Further, the Bill contained provisions for reducing the capital by returning a quarter of a million to the shareholders, but it was necessary to get the sanction of the existing interests. This, the chairman went on to show, they had not yet been able to arrange satisfactorily, as regards terms, with the 3½ per cent. debenture-holders. He would ask them to pass the financial clauses of the Bill, but he might tell them that they were not going to carry them through unless the debenture-holders altered their present position. In regard to the Acton Bill, they had entered into arrangements with the Acton Borough Council for supply to them in bulk on terms already settled. There had been some doubt thrown upon the validity of their supplying even a consenting people though their stations were in this company's area, without the consent of Parliament, so they were going to Parliament for authority to carry it into effect.

The meeting unanimously approved of both Bills.

Anglo-American Telegraph Co.

Mr. F. A. Bevan presided at the meeting held at Winchester House last Friday. He said that there had been a considerable increase (£8,720) in traffic during the half-year, but, unfortunately, the receipts from the *Minia* were only £2,000 as against £12,400 in the corresponding half-year, a decrease of £10,400, which more than wiped out the traffic increase. Taking into account the increased working expenses, there was a diminution in the balance available for dividend. Mr. Lamb, the chief of the Telegraph Department of the Post Office, had lately seen the working of their stock traffic—which required special skill and intelligence—and he said that he had never seen anything that surprised and pleased him more. After a passing reference to the amount in the accounts for pensions contribution (£3,400), the chairman went on to say that there had always been a little friendly discussion upon the subject of the renewal fund, and no doubt some of them had been disappointed to find that, instead of there being an increase in the fund during the last half-year, there had been an actual decrease. The balance on June 30th was £987,000, but now there stood to its credit only £968,927. The items which produced this diminution were explained. The special repairs of the *Minia* had cost £13,680. Up to the date of the previous balance-sheet they had expended £14,000 on these repairs, and he told them that the further sum to be spent in this direction would not exceed £6,000. That amount had been considerably more than doubled. Altogether they had spent £27,680 upon the *Minia* during the year, but the outlay was not only necessary, it had been of the greatest value. The boilers were 20 years old; some of the work was a great deal older than that, and it became absolutely necessary to put the ship in first-rate condition. They believed that they had a ship which was practically a new ship, for the sum of £27,000; the only other alternative would have been to have sold the *Minia* for what she would fetch, and build a new ship, which they would not have done for less than £80,000. The cost of this improvement had made a great hole in the renewal fund. The cost of cable repairs and charter of ship consisted of three large items. One was a break in one of the cables near Valentia. It so happened that many years ago, before any of those who are at present responsible for the management were in power, an experiment was tried with a cable which had been patented by Captain Trott and Mr. Hamilton. That cable was said to be well worth trying, the principal point about it being that there was no iron wiring, and it was supposed that it would be much more easily handled, being so much lighter, but in the course of time they found that this cable could not be lifted at all. The moment they began to deal with it, it went to pieces, and so when a break occurred in it—after many others—they came to the conclusion that it would be far better to cut out the Hamilton-Trott cable and put in real good cable. That cost £14,000. Then there was a break on the other side, which took something like £6,000. Then there was the hire of the steam vessel *Thane* from the Telegraph Construction Co., because the company's own ship was under repair. They had thus to spend money on their own ship, and at the same time to use another to carry out the necessary repairs. The exchange of 2½ per cent. consols for Irish Land stock appeared to have cost £3,442, but the directors did not think that that would really be a loss, as they hoped to wipe it out by the increase in the value of the Land Stock. In regard to the renewal fund, he believed the understanding with the shareholders was that when the fund reached one million, they would cease to charge anything more to revenue, and only credit the fund with the interest on investments, but should there be an accident or breakdown of a cable, the cost of repairs to which would bring the fund below the million, they would have again to debit the revenue until the amount was made up to the million. But at the same time they thought it would not be fair to debit revenue with more than £20,000 in the year, or £10,000 in the half year, unless there should be some great and unforeseen catastrophe, such as having to lay a new cable, for which event they would have to make special arrangements. The fund ought not to ever stand at less than the million, and if it could be increased by the investments, so much the better. Their partners, the Direct Co., had only one cable, against the Anglo four, and they had a renewal fund of nearly half a million, so that the Anglo Co. from that point of view, was only half as well off. After referring once again to the old French lawsuit, the chairman said that the new year had started with a good prospect. Business altogether seemed to be assuming a more flourishing condition, and the company's receipts for the first month had been decidedly satisfactory as compared with the first month in 1904. If they could only go on that way, and had no great and expensive repairs to make, he would hope that they would revert to a state of things where they would not only be able to pay the preferred their 6 per cent., but would have something left for the deferred—but it was dangerous to prophesy.

Sir Gerald Fitzgerald seconded the adoption of the report, and it was carried *nem. con.*

The retiring directors and auditors were re-elected, and a vote of thanks closed the meeting.

Charing Cross and Strand Electricity Supply Corporation.

As announced in last week's Electrical Review, an extraordinary general meeting of the corporation was held at the offices, 60, St. Martin's Lane, W.C., on February 3rd.

The Chairman (Mr. Fladgate) moved the adoption of the resolution approving of the new Bill, and said that one of the resolutions before the meeting was to empower the company to apply to Parliament this session for a Bill enabling them to give bulk supply. Since they had completed their Bow station they had had opportunities of an important character to supply electricity in bulk if they had the power to give it. After careful consideration they decided to apply for power to give such bulk supply to large consumers, such as Government departments, railway companies, dock companies, &c., in various districts, and the districts for which they were asking powers comprised the metropolitan boroughs of "Islington, Stoke Newington, Hackney, Finsbury, Shoreditch, Bethnal Green, Stepney, and Poplar, in the administrative county of London, the county borough of West Ham, the borough of East Ham, and the urban districts of Barking Town, Ilford, Romford, Wanstead, Leyton, Walthamstow, Woodford, Buckhurst Hill, Chingford, and the parish of Dagenham in the rural district of Romford in the county of Essex, and the urban districts of Edmonton, Tottenham, Hornsey, Wood Green, and Southgate in the county of Middlesex." These were the districts which surrounded, and were contiguous to, the Bow station, where they had ample space to provide the power which might be asked for for these districts from time to time. This enterprise, if they got the powers, would bring them in considerable profits.

Mr. H. F. Makins asked, how about the other companies which were also applying for similar powers? Did this company clash with them? And what about the bigger company, which wanted to supply nearly the whole of London? He would like to feel satisfied that they were not all going to adopt a cut-throat policy in regard to which could supply electricity more cheaply than the others.

The Chairman, in reply, said that one of the reasons why they promoted this Bill was to cover a certain amount of ground. They wanted to be in the position to show to the satisfaction of Parliament that the existing London companies, as at present constituted, were not only able to give all the supply which was required for ordinary lighting purposes, but also to give such supply as might be required for bulk or motive power purposes. The company had certain powers under its Act to supply the local authorities of the East End, and it was acting upon that precedent that they had applied for the present further powers. With regard to the question of rivalry, there were two opposing Acts; the first was by a very large company which proposed to embrace the whole of London and a very large district around. The efforts of that company in that direction would be strenuously opposed not only by this company, but in conjunction with at least nine of the other great London companies. The joint objections of 10 companies was coming before a special meeting on the following day. He might say that consequent upon representations made to him by the chairman of one of the other companies, he had provisionally agreed to withdraw a small portion of the district for which they were now asking, for the reason that they did not want to overburden opposition. Shareholders need not be afraid of any rivalry between this and other companies in consequence of this Bill.

The Bill was unanimously approved.

A resolution to change the name of the company to the Charing Cross, West End and City Electricity Supply Co., Ltd., was also passed.

The Chairman announced that the confirmatory meeting, and the annual general meeting, would be held on February 20th.

St. James's and Pall Mall Electric Light Co.

The directors' report for the year ending December 31st, 1904, shows that the supply has been distributed from the Carnaby Street and Mason's Yard stations of this company on a total of 278,889 8-c.p. lamps, being an increase of 24,421 in the 12 months. For this purpose 6,488,589 units were generated at these stations and 2,088,347 were purchased from the Central Electric Supply Co., Ltd. The price charged on the supply of the Central Co. has been

considerably reduced, so that it has not been necessary to draw upon the contingency fund. The Central Co. has recently declared a dividend of 5 per cent. on the ordinary shares, in respect of which a sum of £2,500 will in due course be payable to this company.

The net profits applicable to dividend on shares for the year 1904 were £36,146, add balance brought forward from 1903, £2,745—£38,891; less interim dividend, paid in August last, for half-year ending June 30th, at the rate of 7 per cent. on preference shares, £3,500, and 10 per cent. on ordinary shares, £10,000—£13,500; leaving an amount now to be dealt with of £25,391 9s. 3d. It is now proposed to pay a dividend at the rate of 7 per cent. on the preference shares for the second half-year, £3,500; a dividend on the ordinary shares for the same period of 7s. 6d. per share, and a bonus of 2s. per share, making, with the interim dividend paid on August 1st last, a total distribution of 14½ per cent. for the year, £19,000; leaving £2,891 to be carried forward.

STATEMENT OF ELECTRICITY GENERATED, SOLD, &c., Year ending December 31st, 1904.

Board of Trade units.	Quantity utilised.				Quantity expended in distribution.	No. of lamps on circuit Dec. 31, 1904.
	Private supply.	Public lighting.	Used on works.	Total.		
Generated, 6,488,589 Purchased, 2,088,347	7,966,265	149,076	145,246	7,660,587	916,349	278,889

SYDNEY T. DOBSON, *Chief Engineer.*

Central Electric Supply Co.

THE annual meeting of this company was held at 19, Carnaby Street, W., on Monday last. The proceedings were conducted in private. The following report for the year ending December 31st, 1904, was submitted to the meeting:—

Energy has been supplied to the St. James's and Pall Mall Electric Light Co., Ltd., and the Westminster Electric Supply Corporation, Ltd., throughout the year, to an amount of 6,214,873 units. This increase of output has materially affected the costs of production, and for the past year the company have been able to considerably reduce the charge for supply. A Bill for an extension of the company's powers will be dealt with in the ensuing session of Parliament.

Further debenture stock, amounting to £48,014, has been issued during the year, and the premium on the issue, after deducting the expenses, has been carried to the credit of the capital reserve account.

After making a full allowance for sinking fund and depreciation, the net balance for the year 1904 is..	£604	10 1
Add balance brought forward from 1903	4,402	19 11
Leaving an amount now to be dealt with of	£5,007	10 0
The directors propose to divide this amount as follows:—		
(a) By payment of a dividend at the rate of 5 per cent. on the ordinary shares for the year	£5,000	0 0
(b) Amount to be carried forward	7	10 0
	£5,007	10 0

Great Northern and City Railway Co.

THE Earl of LAUDERDALE presided, on Monday, at the half-yearly meeting of this company.

In moving the adoption of the report, which was abstracted in our last issue, the CHAIRMAN said that the traffic receipts were steadily increasing as the line gained popularity. The gross amount earned during the past half-year was £36,509, against £19,345 for the previous 4½ months, giving an average per week of £1,404, against £967, or an increase of over 45 per cent. while the present weekly traffics were about £1,600. The traffic for the two periods, excluding season tickets, was 5,227,595 passengers, against 2,711,152, or an average per week of 201,061, against 135,557, being an increase of over 48 per cent. The average number for January, 1905, was 256,904 per week, showing that the increase was steadily maintained. The number of local season tickets issued had been 2,511, against 1,563 for the previous 4½ months, and this was also increasing. He might mention the monthly number of passengers from July to January last, exclusive of season ticket holders. In July they carried 702,000, in August 740,000, in September 806,000, in October 910,000, in November 971,000, in December 1,096,000, and last month 1,133,000. Their general through booking arrangements with the Great Northern and other railways were being much appreciated by the public. The optional three-route season ticket arrangement, to which reference was made in the report, was in operation. Their agreement had not yet been finally adjusted with the Great Northern Co., of whose season ticket holders they were, in the meantime, carrying over 2,500 daily. With regard the working of the line there had only been one interruption of any moment, and this was a delay of about 1¾ hours on Sunday evening, September 11th. It was reported to be due to the displacement of a current shoe on the leading motor-car. A few other trains had been three or four minutes late from causes beyond control. There were no other irregularities in the working. During the excessively foggy weather before Christmas their train service was regular and punctual, notwithstanding that, consequent on the fog, there was a very large and sudden influx of traffic from the Gt. Northern Railway. They had been running the same number of trains during the busy periods of the day as they ran in the previous half-year, but consequent upon the opening of Highbury Station and the general increase of traffic, the length of their trains had been increased to five coaches, instead of only three or four. They ran 24 trains per hour, at intervals of 2½ minutes, during the busy hours; at other times the service consisted of two or three car trains. The shortening of the trains outside the busy hours had resulted in considerable economy in working. The car-miles for the half-year amounted to 1,029,948, or 5,597·5 per day, showing an increase of 9·5 per cent. upon the average per day for the previous 4½ months. That this increase was so small, in spite of the fact that the capacity of the trains at the "rush hours" had been increased by 70 per cent., was due to the employment of the two and three car trains. The number of passengers per car-mile when the line was opened was 3·4, while the figure for December was between 7 and 8. This was most encouraging, and compared well with the other tube railways. The *maximum* number of cars in operation for the present service was 54, while they had 58 cars. In order to anticipate further increase of traffic, and to avoid overcrowding, they must have additional cars before next winter, and for some of these the electrical equipment and trucks for motor-cars were already in stock. This matter was now under consideration. The passengers had been carried with perfect safety during the past half-year, and there had been no accidents of any consequence to any member of the staff. The ventilation of the tunnels and stations was very satisfactory, and the purity of the air was all that could be desired, while the temperature remained nearly uniform. The permanent way was of a most substantial character and the running of the trains was especially smooth and free from vibration. The power house at Poole Street provided an adequate reserve of power for any increase in the traffic. The plant was very efficient and economical in working. He would not touch upon the working expenses, as this part of their affairs was in the hands of the contractors, who were responsible for it for a further period of two years. The directors were, however, watching the working very carefully with a view to adopting the most economical methods when the company had to work the line themselves. From what they had seen and from what the contractors told them, the board believed that the line would prove in practice a very cheap one to work. The further estimated expenditure on capital account during the current half-year was £100,000. This was for completing payments in connection with the electrical equipment and the extension of the line to Finsbury Park and for additional rolling stock. Since their last meeting a supplemental agreement had been entered into with the contractors on the final adjustment of their accounts, and by it they undertook to work the line at 60 per cent. of the gross earnings for the first year and at 50 per cent. for the second and third years. Respecting the extension to Lothbury, he regretted that they were not prepared at the moment to expend more money on that undertaking. The money market, in addition to other reasons, held out no immediate prospect of their being able to raise the capital except at a large discount. They wished to feel their way further before embarking upon that project. It was the directors' duty to place the present line on a satisfactory basis before entering on further commitments. They considered, however, that in due time the extension to the bank would be an imperative and profitable addition to the system. The company had a property capable of handling an immense number of passengers, it was thoroughly well equipped and worked, it served a very crowded district, and there was no necessary limit to the expansion of the traffic.

MR. CHARLES STEEL seconded the motion, and after a little discussion, chiefly relating to the form of the accounts, the report was adopted.

Tyneside Tramways and Tramroads Co.

THE directors' report for the half-year ending December 31st, 1904, states that the surplus of receipts over expenses after paying interest on mortgage debentures, loans, &c, is £1,535, which, together with the balance carried forward from the last half-year, viz., £329, makes a total to the credit of the profit and loss account of £1,864. Out of this the directors propose to pay a dividend at the rate of 2 per cent. per annum, and to place £600 to the credit of the reserve fund for renewals, depreciation, and other contingencies, which will leave £58 to be carried forward. The traffic receipts for the year ending December 31st, 1903, were £16,362, while those for the year ended December 31st, 1904, were £19,729, showing an increase in traffic receipts of £3,366, notwithstanding that during the past six months the company had had to meet the competition of the North-Eastern Railway Co.'s electrified lines. The directors repeated that the application to Parliament for running powers in connection with the Newcastle-on-Tyne Corporation lines involved abnormal charges against revenue as well as against capital, and a portion of these charges had been borne by the half-year under review. The running powers authorised were not put into force until the end of August, and then only on two out of the three routes. The receipts had, however, come up to expectation. The directors are making application to Parliament this Session for a Bill to enable them to issue the remaining capital of the company in ordinary or preference shares. The capital thus raised will pay off the present bank overdraft.

The half-yearly meeting was held on the 6th inst. at Newcastle-on-Tyne, Lord Armstrong presiding.

The CHAIRMAN said although they would have liked to have paid a larger dividend, the directors were not dissatisfied with their progress. Apart from slackness of trade which had been general throughout the district, and which had had without doubt some effect on their system, the period had from the company's standpoint been an eventful one. It had seen the termination of the struggle for running powers, the completion of their line to Gosforth Park Racecourse, and the opening of the North-Eastern Railway's electrified system. The last of these events was, he knew, regarded by some of the shareholders as likely to have a very serious effect on their revenue, and while their apprehension was not shared by the directors to the same extent, it was none the less satisfactory to

know that, though the effect of the increased competition had been felt, it had only tended to slightly slacken the rate of increase in their receipts. Referring to the interchange of traffic between the company and the Newcastle-on-Tyne Corporation, he said that during the last four months of the year the interchange had been carried out on two out of three of the routes covered by the agreement. The delay in giving through traffic facilities on the third route arose through difficulties which the Corporation were experiencing in the purchase of a house to widen the roadway near the point of junction. There was no doubt that the results of the interchange had been such as had justified the expenditure involved in obtaining the powers. During the month of April, before the powers had been utilised, the number of passengers in Wallsend travelling to and from the junction between the two systems amounted to 28,627, whereas the equivalent figure in September, after the through traffic had been introduced, was over 66,000. Continuing, he said that since September the operating expenses had been steadily falling, and the total expenses were now below 5½d. per car-mile, and in the published returns there were only two other companies which showed a lower cost.

Dr. MERZ seconded the adoption of the report, which was carried.

A dividend at the rate of 2 per cent. per annum was then declared for the half-year ended December 31st, 1905.

An extraordinary meeting was then held for the purpose of the approving a Bill to come before Parliament to enable th company to issue a portion of their capital as preference shares. It was explained that as the money required to pay off the bank overdraft and sundry creditors could not at present be raised on satisfactory terms by the issue of ordinary shares, and as to raise part of it by issuing preference shares for £20,000 (which could be done under the company's second Act) would prevent further preference shares being issued at any time hereafter, the directors considered it advisable to promote a Bill under which the remainder of the share capital authorised by the first Act could be issued either as preference or ordinary shares, as occasion might require.

The meeting approved of the promotion of the Bill.

Prospectus.—*The Durham Collieries Electric Power Co.* invited subscriptions for an issue of 100,000 £1 preference shares at the end of last week. The company is to erect a central power station at Philadelphia, in the county of Durham, in the immediate vicinity of the Dorothea pit of the Lambton Collieries, Ltd., and of the generating station of the Sunderland District Electric Tramways, Ltd., and in the heart of one of the most important coalfields in England. A contract has been made, for a period of 15 years, to supply all electric energy required by the Lambton Collieries, Ltd., for the Dorothea pit and six other large pits in the neighbourhood, and for other purposes, at ·55d. per unit, until the demand exceeds 18,000 Board of Trade units per diem, when there is to be a reduction in the above-mentioned price to the extent of ·05d. per unit. A contract for a period of 10 years has also been made to supply all the electricity required by the Hetton Coal Co., Ltd., at the Hetton, Eppleton, and Elemore collieries at ·55d. per unit; and a contract to supply for a period of 10 years all the electricity required by the Sunderland District Electric Tramways, Ltd., for working their tramway system at ⅜d. per unit for the first five years of the contract, and ·65d. per unit for the remainder of the contract. It is estimated that the tramway will require at least 1,000,000 units per annum.

Stock Exchange Notices. — The Committee has appointed special settling days as under:—Wednesday, February 15th—Bath Electric Tramways Co., Ltd.—£135,000 4½ per cent. first mortgage debenture stock (also to be officially quoted). Thursday, February 16th.—Mackay Companies—413,598 common shares of $100 each; and 359,382 preferred shares of $100 each. The Committee has also ordered the undermentioned to be quoted in the Official List:—Birmingham and Midland Tramways, Ltd.—£200,000 4½ per cent. first debenture stock, redeemable.

National Telephone Co.—The directors have resolved, subject to final audit, to recommend the following dividends for the half-year ending December 31st last, after payment of the dividends on the preference shares:—At the rate of 6 per cent. per annum on the preferred stock; at the rate of 5 per cent. per annum on the deferred stock, less income-tax, carrying £115,000 to reserve and about £10,000 forward. The transfer books of the company will be closed from the 15th to 28th inst. inclusive, and the dividend warrants will be posted on the latter date.

Chelsea Electricity Supply Co.—The directors have decided to recommend, subject to audit, a dividend on the ordinary shares at the rate of 7½ per cent. per annum for the half-year to December 31st, 1904, making 6 per cent. for the year, carrying forward about £1,170. The dividend for 1903 was 5½ per cent., and the carry forward, £1,100.

Shropshire and Worcestershire Electric Power Co.—The first ordinary general meeting of this company was to be held at 9, Great St. Helens, on Wednesday, 8th inst.

South Metropolitan Electric Light and Power Co.—The Preference Share Register of this company will be closed as from the 15th to the 28th inst., inclusive.

Kensington and Knightsbridge Electric Lighting Co.—The directors recommend a dividend on the ordinary shares at the rate of 10 per cent. per annum for the half-year ended December 31st, 1904, and a bonus of 2 per cent. for the year, making, with the interim dividend paid on August 1st, 12 per cent. for the year 1904. This is the same as in 1903.

Telegraph Construction and Maintenance Co.—The directors recommend a dividend of 10 per cent. (£1 4s. per share), in addition to 5 per cent. already paid, making 15 per cent. for 1904. This compares with 20 per cent. for 1903.

Marconi's Wireless Telegraph Co.—The report for the year ended September 30th, shows a net profit of £12,681, as against £10,607 for the preceding year.

STOCKS AND SHARES.

Wednesday Evening.

CHEERFULNESS prevails in most of the investment departments of the Stock Exchange, and the rumours of peace, alluded to in these columns last week, are still acting as potent levers in support of prices. The gilt-edged divisions particularly enjoy considerable strength, and new issues of first-class stocks are taken with avidity by the public, despite the stale cry occasionally raised that there is no money available for investment. It seems a pity that the Home Railway dividends should, as a whole, be comparatively poor, because a series of good announcements in this market would have added a welcome galvanising touch to similar stocks; but after the mediocre traffics of the second half of 1904, nothing heroic was to have been expected.

Statements are in circulation to the effect that the District will have its electrified service open in a couple of months' time, and the price of the Ordinary stock has risen a point to 41½, while Metropolitan Consolidated at 97½ is 1 better. Central London 4 per cent. Preferred at 106 has come into demand, but the Ordinary is lower at 92. City and South London shows a 10s. advance at 47. These prices all include the recently declared dividends, but most of the Home Railway Ordinary stocks will be quoted *ex* dividend on Friday next, two days hence. There was a little plain speaking at the Great Northern and City Co.'s meeting last Monday, but the criticism then evoked regarding the form of the accounts has not changed the price of the shares, which is still 6½. Great Northern and Piccadilly Ordinary are 9. These, it may be added, are also cumulative dividend quotations. Underground 5 per cent. notes are up ½ at 98½.

Argentine's abortive "revolution" lowered several traction issues rather smartly. Anglo-Argentine Ordinary dropped to 8¼ and the Preference to 5⅝, but the loss was partially overtaken, and the respective prices are 8½ and 5¾. The former displays a fall of ⅞ on balance. Buenos Ayres National Tramway first "A" Preference came on offer at about 6⅝, or cheaper. Belgranos are a shade lower at 4. Weakness in British Electric Traction leaves the Ordinary 15s. lower at 9½, and the Preference ½ down at 11½. The drop is due entirely to the discussion as to whether electric trams may not be superseded by motor-buses. Westinghouse Preference are unpleasantly flat at 2 9/16—practically one-half of their par value. The last dividend paid on the shares was in February, 1904, and now the question is whether anything can be distributed this month. The Debenture stock remains fairly steady at 87, and British Thomson-Houston 4½ per cent. Debenture is 102. Calcutta trams are ⅛ firmer at 9, and Cape Electric Trams are 30s. London United Preference are dullish, for the same cause that makes British Electrics lower, at 10½, and the Debenture stock at 105 has not moved. Some little regret is expressed at the company departing from its original plan of admitting no advertisement either upon the exterior or interior of the cars.

Bear re-purchases, after the recent slump in Anglo-American Telegraph stocks, has sent prices up again with a run, the chairman's speech at the meeting also assisting in the change of market front. The Ordinary and Preferred are both 2 per cent. better, and the latter is being advised in some quarters besides our own, as a good speculative investment. The Deferred stock is 1⅝ better at 13. There is also a 10s. rise in Great Northern Telegraphs, despite the taking over of part of the company's lines in Russia for official purposes. Of course, the company is doing very good business in connection with the war. Eastern Telegraph stock and "China" shares have not altered, but Direct United States Cable shares rose ⅝ in sympathy with the jump in Anglo-Americans. Submarine Cables Trust certificates are a point harder.

National Telephone Deferred has recovered 2 per cent., and both the 4 per cent. Debentures have slightly improved. The Third Preference shares are moving erratically, but on balance the quotation is still 5⅞. Orientals at 1⅛ are a shade better.

Of the Electricity Supply shares, Metropolitans rose 5s. to 18¼ upon sanguine dividend anticipations, and the Preference also advanced 7/16. The satisfactory dividend on Kensington Ordinary shares has led to a 10s. rise, and South Londons have been credited with an additional 5s. at 4½. Several of the Debenture stocks advanced during the week, and Urban Preference have been picked up. Brush Ordinary fell ½ to 10s., but recovered the loss, and the Second Debenture marks a point rise at 76½.

Manufacturing shares are inclined to go better, Henley's putting on 5s. at 11, and Callender's Preference ¼ at 5⅞. A sharp fall in Telegraph Constructions follows upon the lowering of the dividend to 15 per cent. for the year, instead of the 20 per cent. to which the market has grown accustomed.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME,	Stock or Share. ‡	Dividends for the last three years. 1902.	1903.	1904	Closing Quotations Feb. 1st.	Closing Quotations Feb. 8th.	Business done week ended Feb. 8th, 1905. Highest	Lowest.
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —102	99 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	1 — 1½	1 — 1½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,260 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	60/6	61s.	2¾%	56 — 58	58 — 60	59½	59
8,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5¾%	102 — 104	105 — 107	105¾	103
8,105,580	Do. do. do. Deferred	Stock	1/-	2s.	Nil	11⅛ — 11¾	12⅝ — 13⅛	13	11¼
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	..	6⅛ — 6⅜	6⅛ — 6⅜	..	..
13,333,300$	Commercial Cable	$100	8 %	..	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	95 — 97	96 — 97	96¼	96⅜
16,000	Cuba Telegraph	10	6¼%	5 %	..	8⅞ — 9¼	8⅞ — 9¼	9 1/16	..
6,000	Do. 10 % Pref.	10	..	..	..	16⅞ — 17⅛	16⅞ — 17⅛	..	..
12,981	Direct Spanish Telegraph, Ord.	5	..	..	..	3⅜ — 3⅝	3⅜ — 3⅝	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7⅞ — 8¼	7⅞ — 8¼	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	100 — 102	100 — 102	..	..
60,710£	Direct United States Cable	20	3½%	3 %	..	10⅜ — 10⅝	11⅛ — 11⅜	11 3/16	10 13/16
78,500	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	135 —138	135 —138	137⅝	136
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	87 — 89	87 — 89	88⅛	87⅛
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —107	105 —107	107	106⅛
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	13½ — 14	13½ — 14	13⅝	13 7/16
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —106 xd	104 —106 xd	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —103	99 —101 xd	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —102	100 —102	..	..
180,227	Globe Telegraph and Trust	10	£3 16 7*	5½%	..	10¾ — 10¼xd	10¾ — 10¼xd	10⅝	10¼
180,042	Do. do. 6 % Pref.	10	..	..	..	13⅞ — 14⅛xd	13⅞ — 14⅛xd	14 1/16	13⅞
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	..	29½ — 29¾	29½ — 30½	29½	..
50,600	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
17,000	Indo-European Telegraph	25	10%	10 %	..	45 — 47	45 — 47	45½	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	3 %	3 %	..	13/16 — 15/16	13/16 — 15/16	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	108⅛ —109⅜	108½ —109⅜	109¾	107½
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	105 —107	107 — 109	109	104½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	3¾%	5¼ — 5½	5¼ — 5½	5⅜	5⅛
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	4 %	96 — 98	96 — 98	96½	..
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	..	101 —103	101½ —103½	103	102⅜
1,000,000	Do. do. Prov. Certs., all paid	..	..	..	..	101 —103	101½ —103½	..	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6½%	..	1 — 1⅛	1 7/16 — 1 9/16	1 3/16	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1⅛ — 1¼	1⅛ — 1¼	1 3/16	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	96 — 99	97 — 100	..	..
11,889	Reuter's	8	5 %	..	..	7 — 7½	7 — 7½	..	..
8,808	Submarine Cables Trust	Cert.	..	..	..	120 —123	121 —124	..	..
58,000	United River Plate Telephone	5	7 %	..	..	6¾ — 7⅛	6¾ — 7⅛	7⅛	6¾
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	105 —107	105 —107	..	..
15,609	West African Telegraph, Shares	10	2 %	4 %	..	7¼ — 7⅝	7¼ — 7⅝	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,009	2½	..	..	..	1/16 — 1/8	1/16 — 1/8	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	99 —101	99 —101	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	13⅛ — 14	13⅛ — 14	13⅜	13⅛
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —103	101 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	100¾ —102¼	100¾ —102¼	102⅝	102
88,821	West India and Panama Telegraph	10	..	..	..	3/8 — 7/16	3/8 — 7/16	7/16	..
34,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	7⅜ — 7⅝	7¼ — 8	7⅞	7⅛
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	6½ — 7½	6½ — 7½	..	..
60,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	101 —103	101 —103	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

90,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	8¼ — 8⅜	8⅜ — 9¼	..	..
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	9 — 9⅛	9 — 9⅛	..	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	96 —100	96 — 100	..	..
100,000	British Electric Traction	10	8 %	..	..	9⅜ — 10⅛	9 — 9⅛	10 1/16	9 1/16
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	11¼ — 11⅜	11¼ — 11⅜	11⅜	11 1/16
600,000	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	119 —121	122 —120	121	120½
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	95 — 97	97 — 99	98¼	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	..	5¼ — 5⅜	5¼ — 5⅜	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5 — 5⅛xd	5 — 5⅛xd	..	..
60,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 —104	101 —104	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	..	..	..	7/8 — 1 1/16	7/8 — 1 1/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	..	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	..	1/2 — 9/16	1/2 — 9/16	1/2	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	..	1⅛ — 1⅜	1⅛ — 1⅜	1 3/16	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	93 — 96	93 — 96	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	74 — 77	75 — 78	76¾	..
85,000	Callender's Cable Construction shares	5	15 %	12½%	..	9⅛ — 10	9⅛ — 10	9⅜	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	104 —106	104 —106	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	..	92 — 94	91 — 93	93	92
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	..	101 —103	101 —103	102⅜	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	..	85 — 87	85 — 87	..	..
1,330,000	City and South London Railway	Stock	3½%	2¾%	2¾%	46 — 47	46⅛ — 47½	47⅛	46½
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	..	..	2½ — 2¾	2½ — 2⅝	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	99 — 98	293 — 98	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	Nil	..	..	3/8 — 7/16	3/8 — 7/16	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	..	..	1 — 1⅛	1 — 1⅛	..	..
344,028£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82	77 — 82	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 84	79 — 84	..	..
112,100	lectric Construction 1 to 112,100	2	6 %	4 %	..	1⅛ — 1⅜	1⅛ — 1⅜	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2⅛ — 2⅜	2⅛ — 2⅜	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 — 99 xd	297 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	..	..	9⅛ — 10	9⅛ — 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	91 — 96	191 — 96	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	15 %	..	10⅛ — 11	10⅜ — 11⅛	11	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	110 —112	110 —112	..	..
60,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	..	..	15 — 16	15 — 16	15½	..
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102	99 —102	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1¼%	1¾%	1¼%	2⅜ — 3⅜	3⅜ — 4⅛	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	38 — 40	34 — 37	36	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101½ —103½	101½ —103½	..	..
640,000£	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	..	91 — 93	91 — 93	93	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

(Bank rate of discount 3 per cent. (April 21st, 1904).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).— ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME,	Stock or Share.	Dividends for the last three years			Closing Quotations Feb. 1st.	Closing Quotations Feb. 8th.	Business done week ended Feb. 8th, 1905.	
		‡	1902.	1903.	1904.			Highest.	Lowest
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£	8 %	10 %	..	10½ — 11	10½ — 11	..	..
20,000	Do. do. 7 % Cum. Pref. ..	£	..	..	..	10¼ — 10½	10¼ — 10½	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	105 —108	105 —108	..	..
50,000	Charing Cross and Strand Electricity Supply	£	10 %	8 %	..	8¼ — 8⅜	8¼ — 8⅜	8⅜	8¼
70,000	Do. do. do. 4½% Cum. Pref. ..	£	..	..	..	5⅜ — 5½	5⅜ — 5½	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	£	..	..	..	4 15/16 — 5 1/16	4 15/16 — 5 1/16	5	
40,000	Do. do. 1908	£	..	..	..	4 15/16 — 5 1/16	4 15/16 — 5 1/16	5 1/32	5
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	101 —103	102 —104	102⅝	..
44,498	*Chelsea Electricity Supply, Ord.	£	4½%	5½%	6 %	6⅞ — 7⅛	6⅞ — 7⅛	7 1/16	6⅞
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —110	108 —110	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	£	5 %	5 %	..	12 — 12⅛	12 — 12⅛	12⅛	12⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£	..	..	..	13¼ — 14	13¼ — 14	13¼	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	£	..	..	..	121 —125	122 —126	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —104	102 —104	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£	4 %	4 %	..	9 — 9¼	9 — 9¼	..	..
90,000	Do. do. do. 6 % Pref., 40,001—60 ..	£	..	..	..	12 — 12½	12 — 12½	..	..
400,000‡	Do. do. 4½% Deb. Stock	£	..	..	..	107 —110	108 —110	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	101 —103	102 —104	102⅔	102½
70,000	Edmundson's Electric Corporation, Ord. Shares	£	7 %	7 %	..	6¼ — 6½	6¼ — 6½	6 7/16	6 7/16
70,000	Do. do. 6 % Cum. Pref.	£	..	..	..	6 — 6¼	6 — 6¼	6 5/16	6¼
800,000‡	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	106 —108	106 —108	107½	106¾
21,000	Kensington and Knightsbridge Electric Ord.	£	10 %	12%	12 %	12½ — 13	13 — 13½	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —104	102 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	£	..	..	3 %	2⅜ — 2⅝	2⅜ — 2⅝	2½	..
49,840	Do. do. do. 6 % Pref.	£	..	..	..	5⅜ — 5⅝	5⅜ — 5⅝	..	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	96 — 98	96 — 98	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	£	7½%	8½%	..	17⅞ — 18½	18 — 18½	17⅞	..
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£	..	..	..	5⅛ — 5⅜	5 1/16 — 5 1/16	5⅛	..
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	£	..	..	..	110 —115	110 —115	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 98	96 — 98	..	..
10,852	Notting Hill Electric Lighting	£	6 %	6 %	..	14½ — 15½	14½ — 15½	..	..
59,000	Do. do. 4% 1st Mort. Deb.	100	..	..	..	102 —104	102 —104	103	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£	14½%	14½%	14½%	13⅞ — 14¼	13⅞ — 14¼	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	£	..	..	..	8½ — 9	8½ — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —100	98 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£	2½%	4 %	..	2¾ — 3¼	2¾ — 3¼	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	83 — 87	83 — 87	..	..
65,000	South London Electricity Supply, Ord.	£	12½%	8 %	..	4⅛ — 4⅜	4⅛ — 4⅜	4⅛	4⅛
100,000	South Metropolitan Electric Light and Power Ord.	£	..	..	..	¾ — 1	¾ — 1	1 1/16	..
50,000	(*Late Blackheath and Greenwich Dist. E.L.Co.*) 7 % Pref.	£	..	..	..	1⅜ — 1 7/16	1⅜ — 1 7/16	..	..
100,000	4½% 1st Deb. Stock	100	..	..	..	107 —110	107 —110	..	..
80,000	Urban Electric Supply, Ord.	£	..	..	..	5 — 5⅛	5 — 5⅛	5 3/32	..
80,000	Do. do. 5 % Cum. Pref.	£	..	..	..	5 1/16 — 5 3/16	5⅛ — 5¼	5¼	5 3/32
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red ..	100	..	..	..	105 —107	105 —107	106½	..
110,000	Westminster Electric Supply, Ord.	£	12 %	13½%	14%	13 — 13⅛	13 — 13⅛	13⅜	13⅛
98,141	Do. do. 5 % Cum. Pref.	£	..	..	..	6 1/16 — 6 3/16	6 1/16 — 6 3/16	6⅛	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, February 8th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	82/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£5 5	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£18	..
a	Benzole (90 %)	per gal.	7/-	..
a	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£23	..
a	Lead, Nitrate	per ton	£25	..
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£37 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	8d.	..
a	,, Caustic (75/80%)	per ton	£19	..
a	,, Cyanide	per lb.	7½d.	..
a	Shellac	per cwt.	165/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£8	..
a	,, Bichromate, casks	per lb.	9½d.	..
a	,, Cyanide	per lb.	7d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£180	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
b	Babbitt's metal ingots	per ton	£48 to £140	..
c	Brass (rolled metal 2" to 12") basis	per lb.	7½d.	..
c	,, Tube (brazed)	per lb.	9½d.	..
c	,, ,, (solid drawn)	per lb.	8¾d.	..
c	,, Wire, basis	per lb.	7⅞d.	..
c	Copper Tubes (brazed)	per lb.	10d.	..
c	,, ,, (solid drawn) ..	per lb.	10½d.	..
c	Copper Bars (best selected ..	per ton	£80	..

	METALS, &c. (*continued*).		Latest Price.	Fortnight's Dec. or Inc.
g	Copper Sheet	per ton	£80	..
g	,, Rod	per ton	£80	..
e	,, (Electrolytic) Bars ..	per ton	£70 10	..
e	,, Sheets ..	per ton	£87	..
e	,, ,, Rod ..	per ton	£81	..
e	,, ,, H.C. Wire	per lb.	9½d.	..
f	Ebonite Rod	per lb.	8/8	..
f	,, Sheet	per lb.	8/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	5/1 to 5/8½	..
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	47/8½	3½d. dec.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£12 17 6	..
g	,, Sheet	per ton	£14 2 6	..
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£7 12 6	2/6 dec.
d	Mica (in original cases) small ..	per lb.	6d. to 1/	..
d	,, ,, ,, medium	per lb.	2/6 to 4/-	..
d	,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	..
p	,, rolled bars & rods	per lb.	1/0½ to 1/3	..
p	,, ,, strip & sheet	per lb.	1/2	..
o	Platinum	per oz.	81/6	..
e	Silicium Bronze Wire	per lb.	10d. to 11½d.	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£132	..
n	,, Wire, Nos. 1 to 16	per lb.	1/7½	..
p	White Anti-friction Metals— "White Ant" brand ..	per ton	£43 to £65	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	,, 6 lea. Flax	per lb.	5½d.	..
j	,, 3 ply 10 lbs. Russian ..	per lb.	4¼d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£29 7 6	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

Proposal to License Electric Cars.—The town clerk of Dewsbury has been instructed by the T.C. to propose the following resolution at the next meeting of the Association of Municipal Corporations:—"That the President of the Board of Trade be requested to introduce into Parliament a Bill providing for an amendment of the Light Railways Act, 1896, by making provision for the licensing by local authorities of cars plying for hire in the districts of such authorities, with their drivers and conductors, in a similar manner to the provision contained in the Tramways Acts." The Corporation, some time ago, summoned the British Electric Traction Co. for running electric cars for which licenses had not been taken out. The local magistrates imposed a small fine. Against this decision the company appealed, and were successful. It is contended by the Dewsbury Corporation that electric cars should be licensed just as steam cars are.

Installation Regulations.—A few days ago a deputation of Bradford tradesmen laid before the Electricity Committee a scheme for rules and regulations to which contractors had to adhere in fixing installations in the city. The deputation consisted of Mr. W. P. Steinthal, vice-president of the Leeds Section of the Electrical Contractors' Association (Incorporated), Mr. James Davis, and Mr. P. Collinson, secretary. A report was presented in detail to the Committee of the changes which the deputation desired on behalf of the members of the Association, and the Committee said the matter should have careful attention.

City and Guilds Institute.—The distribution of prizes to students of this Institute will be held at the Mansion House on Saturday, 25th inst. An address will be delivered by Mr. Alexander Siemens.

THE FUTURE OF RAILWAYS.

By PHILIP DAWSON.

(*Continued from page* 206.)

Increased facilities of traffic always result in greatly increased travelling, and the evidence of Mr. Harper before the Royal Commission on London Traffic shows the enormous increase in the passenger traffic in the London area in the last 30 years. It not only shows this, but also brings out the urgent necessity for increased facilities. The figures given by Mr. Harper (see Table I.) do not include either

TABLE I.—Increase of Passenger Traffic in Greater London (Edgar Harper).

Year.	Number of passengers carried by Railway (local companies).	Tramway.	Omnibus (two principal companies).	Total.	Estimated population of Greater London.	Number of journeys per head.
1867	40,547,398	Information not available.	41,424,428	81,971,826*	3,605,510	22·7
1868	47,533,915		40,968,187	88,502,102*	3,673,591	24·1
1869	57,514,541		41,047,521	98,562,062*	3,742,956	26·4
1870	59,424,414		42,935,471	102,359,885*	3,813,632	26·8
1871	72,636,913		43,556,545	116,192,858*	3,885,641	29·9
1872	9 ,6 ,677		44,523,361	136,222,038*	3,965,864	34·4
1873	89,773,798		46,066,247	135,840,045*	4,047,745	33·6
1874	94,205,584		48,538,896	140,744,480*	4,131,315	34·1
1875	105,659,125		49,720,038	155,379,163*	4,216,611	36·9
1876	115,326,889		51,157,946	166,484,835*	4,303,668	38·6
1877	121,381,637		52,853,630	174,235,267*	4,392,521	39·6
1878	126,241,393	53,387,498	56,039,295	235,668,186	4,483,210	52·7
1879	129,554,171	56,341,767	55,531,827	241,427,765	4,575,771	52·7
1880	133,877,485	64,817,361	57,742,231	256,417,077	4,670,243	54·8
1881	139,239,690	72,038,962	58,389,997	269,662,649	4,766,661	56·6
1882	141,036,783	86,700,382	64,251,230	291,888,315	4,847,001	60·2
1883	151,076,112	99,029,709	67,888,416	317,994,537	4,928,695	64·5
1884	149,842,029	115,074,804	78,178,516	343,095,349	5,011,765	68·5
1885	159,235,899	127,280,383	83,883,168	370,398,950	5,096,235	72·7
1886	165,050,887	132,529,504	90,708,966	388,289,357	5,182,120	74·9
1887	157,789,526	145,902,087	108,323,689	412,015,252	5,269,174	78·2
1888	160,254,377	154,922,236	118,078,103	433,249,716	5,358,286	80·8
1889	161,501,818	170,542,740	133,722,139	465,766,697	5,448,599	85·5
1890	167,299,200	191,041,904	148,581,099	506,872,203	5,540,130	91·5
1891*	180,026,117	198,569,584	158,926,250	537,521,951	5,633,805	95·4
1892	181,889,024	207,885,926	172,623,667	562,348,617	5,726,997	98·2
1893	179,163,255	215,805,947	179,504,329	573,973,531	5,822,613	98 5
1894	184,428,007	231,522,014	179,742,122	595,692,143	5,920,732	100 6
1895	184,411,600	249,996,979	191,076,010	625,481,589	6,021,483	103·9
1896	189,584,863	279,518,865	212,622,471	681,732,199	6,124,812	111·3
1897	196,900,218	297,577,280	231,205,048	725,682,531	6,210,779	116·8
1898	194,051,872	312,464,404	242,164,485	748,680,761	6,299,321	118·9
1899	196,505,405	306,515,907	261,019,056	764 039,7?8	6,390,534	119·6
1900	214,537,095	340,203,066	264,503,868	819,244,029	6,484,516	126·3
1901	236,506,162	340,772,414	269,933,759	847,212,335	6,581,402	128·7

* Excludes tramway passengers.

Note.—The railway companies included in the above table are the Metropolitan, Metropolitan District, North London, East London, City and South London, Waterloo and City, and Central London. The omnibus companies included are the London General and the London Road Car. The tramway column includes all tramway traffic.

main line or suburban traffic, but simply deal with passengers carried by railways such as the Metropolitan, the Metropolitan District, the North London and the Central London Railway, and the tramways and omnibuses. An examination of the figures given shows that in the last decade the number of passengers has increased by nearly 60 per cent. This shows the necessity of taking steps to provide increased facilities for getting into and out of London as well as to extend the area in which the day population of London can live. Parallel with the growth of the population of London is that of towns such as Croydon, where the population has doubled within the last 25 years, and is still growing very rapidly.

Mr. Edgar Harper shows that whereas in 1867 the population was carried 22·7 times, in 1901 it was carried 128·7 times. These figures deal only with the traffic in the London area, and do not include the passengers brought in by suburban trains. It should also be noted that these figures do not include the omnibus lines.

It is interesting to note that the number of journeys per head of population in London is at present small compared to that in many other large cities, as will be seen by the following figures:—

London, 1901 ... 129 journeys.
Glasgow, 1901 ... 174 „
Liverpool, 1901... 187 „
London (Mr. Harper's estimate) 1903 ... ... 200 journeys.
Berlin (Mr. Harper's estimate) 1903 ... ... 223 journeys.
Greater New York (Mr. Harper's estimate) 1903 320 journeys.

Facilities for traffic always create traffic, and as facilities are improved traffic will not only be actually but also relatively greater. This is shown by the following figures:—

Increase in Number of Journeys per Head of Population.

Greater London.		*Greater New York.*	
1867	23	1860	47
1870	27	1870	118
1880	55	1880	182
1890	92	1890	283
1900	126	1900	320
1903 (estimated)... ...	200	1903 (estimated)... ...	415

Mr. Harper, in discussing the growth of the population of London, also shows that the greatest increase has taken place in those areas where reasonable and cheap facilities are available for travelling to and from the business centres, and that on the contrary, where this is not the case, and where the railway journey occupies a relatively long time, the population has not increased to a very great extent. If the railway companies wait for the population to grow up before providing the necessary frequent and rapid trains, they will wait in vain, and there will be no demand; but if they give the requisite facilities, these will create the demand.

As regards workmen, the evidence given before the Royal Commission shows that the average rent per room in London for the working man is 3s. 3½d., whereas outside London it would probably not be more than 2s., or a saving per room of 1s. 3½d. per week, which amount, at least, a working man should be willing to spend on travelling to and from his work. Probably he would be willing to spend more, as outside London living would be cheaper and the life healthier for his wife and family.

A study of the rates and taxes shows that on the whole it would be considerably cheaper to live outside the County of London than inside. Table II. gives a few examples. It

TABLE II.—Rates and Taxes (Per £1 Assessed Rental Value) in Various Districts of London and its Suburbs.

District.	County rate.	Poor rate.	Borough rate.	Total.
County of London:	s. d.	s. d.	s. d.	s. d.
Borough of Battersea ...	5 2·18	0 7·40	1 11·42	7 9
„ Bermondsey	5 0·13	2 4·21	1 6·47	8 11
„ Camberwell	5 0·20	1 4·51	1 8·29	8 1
„ Deptford ...	5 2·42	1 3·81	0 7·77	7 2
„ Lambeth ...	4 11·10	0 8·64	1 5·26	7 1
„ Lewisham	5 3·19	0 8·04	1 6·72	7 6
„ Southwark	5 0·05	0 6·94	1 6·26	7 1
„ Wandsworth	4 10·91	0 7·22	1 8·67	7 3
	Poor rate.	General district rate.	Special expenses.	
County Borough of Croydon...	3 2	3 8	—	6 10
Rural District of Croydon:				
Parish of Beddington ...	3 4	—	3 0½	6 4½
„ Coulsdon ...	3 4	—	1 6½	4 10½
„ Merton ...	3 9	—	2 3	6 0
„ Sanderstead ...	3 4	—	1 0	4 4
„ Woodmansterne	3 5	—	0 7	4 0
Hamlet of Wallington ...	3 5	—	2 8½	6 1½
Urban District of Beckenham:				
Parish of Beckenham, Hamlet of Penge	2 7	3 0	—	5 7
U.D. and Parish of Sutton ..	2 8	3 4	—	6 0
U.D. and Parish of Wimbledon	2 4	4 0	—	6 4

must also be remembered that even with the same rates and taxes per £1 assessed rental value, it means less annual expenditure on account of the lower rents in the rural districts, so that in those cases where the rates are actually lower, the saving per annum is very considerable.

The great impetus that has been given to the building of small houses in the North-east of London is practically entirely due to the good train service offered, particularly to the labouring classes, by the railway companies in that district, whereas, in the absence of such facilities, large tracts of land remain undeveloped.

The area known as Greater London is formed of suburban districts which, with the exception, perhaps, of Boston, U.S.A., have not their counterpart in any other part of the world. The City is closely built, and in the daytime densely

populated. It is situated within a semi-rural district in which are the homes of those employed in it, who pass the nights, and whose families live, in the purer and healthier atmosphere of the country. Even with the present steam service, the population of the districts near the heart of the City has not only ceased to grow, but the number of inhabitants is declining. A similar case is that of the City of Liverpool, the population of which is less now than it was ten years ago, while the population of the neighbouring districts has increased rapidly. The population of the City of London and its immediate neighbourhood is also decreasing; on the other hand, the population of its suburban districts has been very rapidly increasing within the last 20 years. This most desirable spreading of the population would be largely helped by a cheap, rapid and frequent service of trains between the City and suburbs.

The evidence taken by the Royal Commission on London Traffic, and the remarks made thereon by the Commissioners, show that they attach great importance to the equable distribution of the population by the railways, and are of opinion that the latter should anticipate and foster the growth of population in certain districts instead of waiting for the increase before giving proper facilities.

(*To be continued.*)

THE BRITISH ENGINEERING INDUSTRIES AND THE FISCAL INQUIRY.

II.*—Lost Time in the Engineering Trades.

The second sub-section of that portion of the return which is devoted to fluctuations in employment is concerned specifically with the analysis of the time lost by workpeople through want of employment and other causes in the engineering trade only. The first table to which reference must be made is that relating to the distribution of unemployment according to age. The following table has been prepared from the "vacant" books (*i.e.*, the books in which the unemployed enter their names) of the Amalgamated Society of Engineers. The average time lost was distributed as follows:—

Average Number of Days Lost in a Year.

Members between 15 and 25 years of age	8·8
„ 25 „ 35 „	13·1
„ 35 „ 45 „	12·3
„ 45 „ 55 „	20·1
„ 55 „ 65 „	33·1
Members 65 and over (excluding superannuated) ...	26·9

The "vacant" books on which the above analysis is based take no account of time lost through "short time," sickness, unpunctuality, or trade disputes, or of the gain by working overtime. The average loss of time through sickness is about 2½ per cent., while over a long period of years about 1 per cent. of the working time of the Amalgamated Society of Engineers was lost through trade disputes.

In regard to overtime and lost time, the Trade Union records give no information, but a special inquiry was addressed to 38 firms employing about 15,000 workpeople. The returns from these 38 firms concerned the actual results of 1895 only, but 18 firms employing 4,500 hands supplied similar information for 1890 and 1893. These returns show that the average number of hours overtime worked per week per man employed was as follows:—

Year.	Number of firms.	Number of employés.	Average hours overtime per week.
1890 (year of active trade) ...	18	4,588	2·5
1893 (year of bad trade) ...	18	4,287	1·3
1895 (year of medium trade) ...	18	4,521	1·9
	38	15,109	2·0

In the year of medium trade, an average workman in the engineering trade works an average of 2 hours a week overtime, thus increasing his working time by 3¾ per cent.; this amount is increased in times of activity, and decreased in times of depression.

Short time—*i.e.*, the shortening of the hours during which an establishment is at work in times of slack trade—is not prevalent in most districts in the engineering trade. The deductions which should be made on this account are probably small.

Through unpunctuality in the morning, the working engineer loses a great portion of his working day; this loss varies with the state of employment, being considerably greater in times of activity than in years of depression. In years of good wages and full employment, with a greater prevalence of overtime, the average artisan is less chary about "losing a quarter," and when the stress of slackness comes, the worst time-keepers are the first to get "sacked." Information was supplied to the Department by 15 firms employing 10,664 workpeople in London, Manchester, Leeds and Hull as to the loss of time through unpunctuality. On the average, these workmen lost 8,221 hours per week, or rather over three-quarters of an hour per man employed.

From the data above recited, a final analysis of lost time of the average engineering workman can be prepared. Through unemployment 4 per cent., through sickness 2½ per cent., through unpunctuality 1½ per cent., and allowing 1 per cent. for trade disputes, a total loss of 9 per cent. is incurred. Overtime amounting to 3¾ per cent. gives a net loss of 5¼ per cent. To this deduction must be added the loss of time through general holidays, bank holidays, and other customary stoppages, which are estimated to amount to about nine days, or nearly 3 per cent. of the full working time in the engineering trades. For an average year the final deduction to be made is about 8 per cent. of the working time. In a good year the net deduction may be as low as 4 per cent., and in a bad year it may rise to 15 per cent. or more.

As regards foreign countries no unemployed statistics exist on a basis which will allow comparison to be made of the actual level of employment in that country and in the United Kingdom respectively during a given time. In the opinion of the Board of Trade the only sound method available in the United Kingdom of comparing employment over a long period is that afforded by the trade union payments in the shape of unemployed benefit. The available statistics do not show whether at a given time employment is more or less abundant in one country than in another; they do, however, show that in the brief periods covered by the several reviews, trade has become more or less abundant in a particular country. As regards Germany, the returns from the public labour registries between 1898 and 1903 show that whereas 1899 and 1900 were years of prosperity, 1901 and 1902 show the demands on the bureau 50 per cent. greater, while the figures of 1903, although showing an improvement, indicate that the labour market has not yet gone back to the busy time of 1898. The German trade union returns are only available for 12 months, and, therefore, with the Norwegian figures, which only cover a similar period, need not be quoted. Figures are given of the Belgian metal trades which follow pretty closely the British figures during the same years. None of the French figures cover the returns of engineers' unions, although the figures concerning coal mining show that the French collier works more days a week than his British *confrère*. The figures from the United States of the unions concerned in the metal and machinery trades from 1897 to 1902 show that the latter year was for the States a year of minimum percentage unemployment, while 1900 and 1901 were years of greater stress.

No figures are given as to the loss of time through unpunctuality or statutory holidays in Germany. It would be a most valuable lesson to the shipwrights on the Tyne, if the time lost by unpunctuality and drink were contrasted with that lost at Stettin, or if the time lost on Mondays only by each 100 fitters at Coventry were contrasted with the time lost by 100 fitters at the works of a firm of Berlin toolmakers on the same day of the week. It is the opinion of engineers who have been in Germany that the German artisan is a superior time-keeper to his British *confrère*. It will be well if successive returns give figures respecting the punctuality and great regularity of the artisans of other nations.

* No. I. appeared in our issue of February 3rd, p. 168.

Gomersal Tramways. — The U.D.C. has decided to strongly oppose the application of the Dewsbury, Batley and Birstall Tramway Co. for an extension of time for the electrification of the lines.

MORE ABOUT ELECTRICAL DEVELOPMENT IN CANADA.

In our issue of December 30th we entered in some detail into the prospects of future British electrical engineering development in Canada. From remarks that have since reached us, we obtain confirmation of our belief that the matter is one of considerable interest at the present moment, and we return to it in the hope that what we have to say may be of service to some who are contemplating, or already making, special efforts to lay a proper foundation for British electrical trade in this part of our Empire.

A few weeks ago we published a letter from Mr. Harison Watson, the Canadian Government's city trade representative in London, expressing his willingness to render any possible assistance to firms wishing to open up a connection with the Dominion. We have since had an interview with Mr. Watson at 73, Basinghall Street, and have found him to be filled almost to overflowing with interesting information relating to Canadian industries and the desirability of British houses paying closer and more energetic and efficient attention to the market. So far as electrical trade is concerned, Mr. Watson was able to give us the latest official returns of electrical imports into Canada; they are for the fiscal year ended at June, 1904, and afford abundant evidence of American activity, and are well worthy of study. We merely give the British and American figures, the difference between these and the totals stated, being made up by business done with Germany and other Continental countries.

Electric Light Carbons and Carbon Points of all kinds.

Great Britain...	$153
United States	22,036
Total	$25,985

Electric Carbons over 6 in. in Circumference.

United States (exclusively)	$62,794

Electric Apparatus, Insulators of all kinds, &c., Electric and Galvanic Batteries, Telegraph and Telephonic Instruments.

Great Britain...	$29,403
United States	1,807,188
Total	$1,842,026

Electric Motors, Generators, Dynamos and Sockets.

Great Britain...	$29,758
United States	459,813
Total	$504,571

From our interview with Mr. Harison Watson, we gather that he is most ready to impart whatever information may be in his possession regarding any particular points upon which British electrical firms may need enlightenment. We understand that the Canadian Government has also stationed men of sound commercial knowledge respecting the Canadian markets in several provincial cities, with a view to acquainting our manufacturers with the true position of affairs, and encouraging more extensive Anglo-Canadian trade relations.

An ex-Canadian who is now in business in this country has placed before us a copy of a letter received a few weeks ago from a Scotch Canadian who is engaged in electrical work in Montreal. He, by a very forceful illustration, shows that a slipshod examination of the market and its needs is worse than useless; and, further, that there is no room for indiscretion on the part of those who are travelling in search of electrical orders. It appears that the representative of a certain English firm brought home a bad report regarding the prospects of doing business over there. But why *was* his report a bad one? "The first thing he did was to go to a small plumber . . . . and quote him for English tumbler switches. The plumber was a special customer of a large Canadian electrical house and had no intention of importing, but merely used the British traveller's prices to beat down the wholesale house." Of course, therefore, when the traveller reached the wholesale house he had a bad reception. That is hardly to be wondered at. This same traveller seemed bent on making trouble for himself, for he subsequently went to a French electrical firm and quoted his prices while the traveller of a large wholesale Canadian house was in the place. His success quite naturally was nil, but he was slow to take advice, being one of the sort who know everything already.

Our correspondent makes a stinging charge of sharp practice against "another leading English house." . . . "Certainly I will never attempt to do business with either of these firms again."

We did a little business with a Birmingham firm, and accepted their draft in the regular way when presented, but when we went to pay it at the bank we were pretty much surprised, and so were the bank, to find that interest was chargeable from date of acceptance to date of payment.

I know you are an Englishman, but would just like to point out that it is not only the Yankees who can play sharp games in business, and so long as such tactics continue, you will find it exceedingly difficult to do business in Canada.

He continues :—

Another instance, of a different kind, was that of a firm at ——, who are in the pottery business, and make electrical chinaware. Their traveller called and begged for samples and a chance to quote. We gave him samples of cleats, knobs, &c., and received a quotation 1d. per cleat f.o.b. Manchester. These are sold to us locally at $10 per 1,000, *i.e.*, ½d. each. You can see the difference. We mentioned this price to the firm, but they did not seem to credit it, although we could readily prove to them that we could buy the same goods f.o.b. Hamburg at $5.85 per 1,000 cleats, which, in spite of German Differential Tariff, would amount to less landed here.

Another firm to whom we sent a sample of silk-covered cord, sent back a quotation by the *mile*, and asked how many thousand miles they could have the honour of shipping us. Whether this was meant as sarcasm, or a piece of idiocy, I leave you to judge. United States manufacturers quote this cord per 100 or per 1,000 yards, and we presume the usual English manner would be per gross yards, or per dozen gross yards, as this class of material is not strung up on poles.

We have some Canadian sharks, and the enclosed letter points to one in the shape of a newspaper published here, which is not worth 10 cents a year, and is never read by anyone unless he has considerable time on his hands. No doubt they are procuring advertising contracts in England, and if you can save anyone from being bled by this medium, you would do a good turn.

For ourselves, we have determined to shake the dust off our feet as regards London, and go north of the Tweed, and if you can give me any address of wire manufacturers, or of makers of electrical fittings such as we use, in Glasgow, I shall feel obliged.

We think it will be well if English manufacturers and traders give more than a passing supercilious scorn to this letter. There is no room nowadays for tampering or playing with any of the world's markets; much less is there room for helping American and other competitors in a market which may, if properly cultivated, one day become of great value to us electrically. We print the foregoing strictures for what they are worth. We have no means of verifying them, but neither have we any reason to doubt the veracity of our correspondent.

Reverting to the general question of the future of Canada, let us quote some remarks made by Sir Wm. H. White in his recent address to the Institution of Civil Engineers on the visit to the U.S.A. and Canada :—

No engineer visiting Canada could fail to be impressed by the enterprise and courage with which the Government and private associations were facing great schemes for the development of the Dominion's resources—the construction of a new trans-Continental railway, the improvement of the water-ways between the great lakes and the Atlantic, the fuller utilisation of numerous sources of water power for industrial purposes, and the production of electrical power, &c.—and when it was remembered that the total population of Canada was only about 5½ millions of people, the scale and cost of these great engineering works seemed even more remarkable. Many opportunities were afforded to see examples of the utilisation of water power, and no one could fail to realise the enormous possibilities of development in the pulp and paper industry, with cheap power and a good supply of labour. They were informed that within a few miles of Ottawa there were 200,000 H.P. of water power and within a radius of 45 miles nearly a million horse-power. At Niagara on the Canadian side three new undertakings were being rapidly advanced, together giving over 400,000 H.P., while a fourth would yield 40,000 H.P. When these were completed the grand total of power derived from Niagara on both sides of the river would be about 700,000 H.P. Two of the three big undertakings on the Canadian side were practically due to American capital and enterprise—a fact that did not redound to our credit in view of the enormous amount of British capital available for investment. The third was distinctively Canadian and was closely associated with Toronto. The capital of this company was 1½ millions sterling, and its total development of power would be 125,000 H.P.; these figures gave some indication of the enormous expenditure required in the Niagara district to develop 700,000 H.P.

The development of the Dominion was in an early stage, but those charged with the responsibility of government were fully alive to the grandeur of its resources, and its potential greatness. The realisation of this policy depended largely upon the execution of engineering works of enormous magnitude. Those who took part in this visit had but a glimpse of what was being done to utilise the

natural advantages of the country, but enough was seen to make it certain that in Canada was to be found a splendid field for British enterprise and capital. Canadian engineers, without exception, expressed the hope that, in the organisation and conduct of the great works now contemplated or to be undertaken hereafter, they would have the assistance of British engineers, and especially of young engineers. No better school for aspirants in the profession could be found than that afforded by the Dominion. What was true of Canada was true also of our other Colonies and dependencies, and it might be hoped that British enterprise and capital would be more devoted in the future to the development of the resources of the British Empire and less to corresponding work in foreign countries.

Our readers will remember that, in our issue of December 30th, 1904, we emphasised the need for increased investment of British capital in connection with Canadian development.

We have already given official figures relating to electric lighting, tramway and manufacturing work in Canada. Perhaps it will be of engineering interest to refer to the interesting report which was recently prepared by Mr. S. E. Fedden, the general manager and engineer of the Sheffield municipal electric light and power system, on "Electrical Industry in the United States and Canada." Mr. Fedden went over there last year to visit the St. Louis Exhibition, "with a view to informing himself of the most up-to-date electrical appliances." He took advantage of the trip organised by the Institutes of Civil Engineers of America and Canada to visit Montreal, Quebec, Ottawa, Toronto and Niagara. Some of his particulars may be of interest in connection with the present article, and with his permission we propose to make some lengthy extracts from the report.

Water-power facilities are very plentiful, therefore most of the generating plant is operated by water-driven turbines, to which alternators are connected direct, when the height of the fall is sufficient; and where only a small head of water is obtainable, they are driven through a line of shafting.

Montreal (population, 350,000).—The electrical energy consumed in the city of Montreal is supplied from three water-driven turbine power houses, viz, the Chambly, the Lachine, and the Shawinigan stations, which are situated 5, 17 and 85 miles respectively from the city, and in consequence of the long distance over which the power has to be transmitted the voltages are raised to 5,000, 25,000 and 50,000. Two of the stations—the Chambly and Lachine—are owned and worked by the Montreal Light, Heat and Power Co, which company has the entire control of the electricity supply in Montreal. The consumers connected to their mains number 10,600 for lighting, and 880 for power, &c.; or, say, 3·3 per cent. of the population, as against 0·8 per cent. in Sheffield. Such comparisons, of course, are very approximate and must not be pushed too far. In addition a large supply of energy is taken for street lighting purposes and tramways, some 85 million units being consumed per annum. The big motor load enables a very high load factor to be obtained, which averages 75 per cent. throughout the year.

This is largely owing to the arrangement of charges which are extremely low to very large customers, on condition that they take no current during the dark months, between 4 and 7 p.m. This, says Mr. Fedden, entails very simple changes in the working hours, quite possible to many trades, and is worthy of more attention than it has yet received in this country as a means of reducing the overlapping of motor and lighting loads at the peak time, which does much to keep up the capital cost and price per unit.

At the Chambly station, 17 miles distant, the plant capacity is 17,000 KW. Current is generated at 2,200 volts two-phase, and by the use of specially connected step-up transformers is converted to three-phase 25,000 volts for transmission by overhead wires to the various sub-stations in the city, and from there it is distributed to consumers' premises, either two or three-phase, alternating or direct current and at varying voltages.

The Lachine station, which is only five miles away from the city, has a total capacity of 6,000 KW. The current is dealt with in a similar manner as at the Chambly station, with the exception that as the distance for transmission is much less the pressure is only stepped up to 5,000 volts.

(To be concluded.)

INSTITUTION OF ELECTRICAL ENGINEERS.

BIRMINGHAM LOCAL SECTION.

On January 25th Dr. D. K MORRIS read an interesting paper, illustrated by lantern slides, on "The American Visit of the Institution of Electrical Engineers," of which the following is an abstract. The first portion of the paper consisted of a brief outline of the tour. Proceeding to technical details, the author first dealt with central stations having steam generating sets. Of these they saw a large number, more especially in New York. This city possesses five huge central stations in addition to a number of smaller ones in outlying parts. The former are:—

1. The "Waterside," or 38th Street station of the Edison Co., built for an output of over 75,000 KW. This station deals with most of the lighting of the city on the 110-volt three-wire system.

2 The 96th Street station of the Street Railway or tramway system, of 40,000 KW.

3 The Kingsbridge station, also working mainly on tramway load, and capable of an output of 30,000 KW.

4. The 74th Street station, which supplies the power which operates the New York Elevated railroad. This is found to require at times a total of 50,000 KW., which is at least 5,000 KW. in excess of the station capacity. This excess is provided by the 59th Street station.

5. The 59th Street station was built to supply power to the recently opened New York Subway, and is equipped with plant of more than 50,000 KW. capacity.

A station of 60,000 KW. ultimate output is also being equipped in Brooklyn.

The above shows the enormous demand for electric power in New York. Boston and Chicago have each two stations of similar output, and other great cities are proportionally equipped. The standard size of unit is 3,500 KW. in the older to 5,000 KW. in the newer stations. A temporary overload capacity of even 50 per cent. on these figures is occasionally demanded. The generators are wound three-phase for 6,600, or 11,000 volts, speed 70 to 75 r.p.m., frequency 25. The maximum efficiency of such generators is over 97 per cent.

The engines are largely of the vertical cross-compound condensing type, with Corliss gear. In some cases the two high-pressure cylinders are placed horizontal, and the cranks at 135°, thus securing eight impulses per revolution. This facilitates parallel running.

In most of the newer stations steam turbines and high speed alternators are being put down. Many stations which were obviously designed and built for large low-speed engines, have been installed with turbine sets. Stations designed at the outset for vertical shaft Curtis turbines are, however, to be found at Boston and Chicago. Here the standard turbine set is of 5,000 KW. output, at 500 r.p.m. The floor space occupied is less than half that of one of the old 1,500 KW. low-speed engine sets. In Boston the turbine generators are three-phase, 7,500 volts, 60 cycles.

Besides the Curtis turbine, which is manufactured by the General Electric Co., at Schenectady, the British Westinghouse Co., do a large business in the Parsons type. The author, however, gained the impression that the small vanes and high speed of the latter did not lead to such good results as with the Curtis type.

The most noticeable feature in connection with the switchgear, is the motor-operated high-tension switch. It is common practice to place these switches in a separate building, in order to minimise fire risks.

Sub-stations are usually equipped with 1,000—1,500-KW. rotary converters running at 115 r.p.m., and having an efficiency of about 97 per cent., to suit which the pressure is transformed down to 175 volts. Batteries are usually provided.

The large and now well-known stations on the American side of the Niagara Falls are small when compared with the vast schemes on the Canadian side. The Canadian Niagara Falls Co. are building a 110,000-H.P. station; the Electric Development Co., of Ontario, one of 125,000 H.P.; the Ontario Power Co. is starting a 135,000-H.P. scheme. The greater portion of this power will be taken by Toronto, 60 miles distant. The pressure of transmission is to be 60,000 volts.

The lesser known Falls at Shawinigan proved fully as interesting to the party as did Niagara. The power station is situated at the foot of the Falls, and is of 30,000 H.P. capacity. Directly above the station at the head of the falls is a large aluminium works, to which low tension direct current is supplied, two sets of aluminium rods of 22 sq. in. section being used for the short transmission. With the exception of this direct-current set, the generators are two-phase, 2,200 volts Westinghouse and Dick, Kerr types. The current is transformed, as in the older stations at Niagara, to three-phase by means of Scott-connected transformers. The power is transmitted at 50,000 volts to Montreal, 83 miles distant, by aluminium wires at 60 in. spacing, the pressure drop being 18 per cent. for 5,000 KW.

The author then dealt with electric traction methods, mentioning many interesting details. He was much struck by the amount of time and labour that the firms in America were devoting to the single-phase traction problem.

In conclusion, he considered that in nearly every case the greater advances made in electrical engineering in America, compared with this country, were due to the larger scale upon which necessity compelled them to work. The presence of ample water power at great distances from the large industrial centres, gave rise to large long-distance systems of transmission. Their traction schemes were on a large scale. There were disadvantages in connection with the possession of such large organisations as the General Electric Co. and the Westinghouse Co. There was a tendency to retain well-tried, but partially obsolete methods. There were, however, many advantages, the most real being the enormous resources, which could be directed to the development of great new problems, such as the perfecting of the steam turbine, the improvement of single-phase traction methods, and the working at the highest voltage limits in power transmission.

In the discussion, Mr. VAUDREY called attention to the immense size of all the electrical undertakings mentioned. Stations having a capacity of 100,000 H.P. could not be approached in this country.

Mr. TAYLOR asked for information as to the length of time during which the 50 per cent. overload mentioned by the author could be maintained. He understood from descriptions of recent tests made on large sets in New York that the maximum efficiency

figure reached was 96 per cent., and he would like to know if the exciting current had been included. The frequency of 60 cycles per second, mentioned in connection with turbine sets, seemed to him excessive.

Other members also asked questions on various points. Dr. Morris, in replying, said that the price at which energy was supplied for lighting in America was often comparatively high, about 6d. to 8d. per unit. But for power it was about 1½d. per unit, leaving out of consideration exceptional cases like Montreal, where, subject to a restricted-hours clause, the charge did not work out to more than ½d. per unit. In connection with prices, however, it should be remembered that the purchasing value of money was about two-thirds that of the same amount in this country. This probably accounted for the high rate. The 50 per cent. overload capacity he had mentioned might, with safety, be applied for 5 to 10 minutes. The efficiency figure of 97 per cent. was for a very large generator. At 25 per cent. overload the efficiency was 97·2 per cent. 60 cycles per second was the frequency of the generators for the lighting system at Boston, but the actual lighting was mostly D.C. 25 cycles was the standard for the A.C. transmission. Batteries in sub-stations were usually kept floating on the mains, and were thus used for the peak load. The 110-volt system of supply for lighting had established itself as the standard voltage of the Edison combination. When the supply companies introduced high tension A.C transmission, they found it as easy to transform down for 110 volts as for 220. The closeness of the converter sub-stations, due to the congested districts supplied, brought the areas well within the range of 110-volt distribution. The Edison illuminating companies used the General Electric Co.'s watt-hour-meters almost exclusively. Quantity meters were very little used, if at all.

A vote of thanks was accorded to Dr. Morris for his paper.

FARADAY SOCIETY.

The Faraday Society opened its new session on Monday, January 30th, with an interesting and highly suggestive paper by Mr. John G. A. Rhodin, entitled "Mass Analyses of Muntz's Metal by Electrolysis, and some Notes on the Electrolytic Properties of this Alloy." Prof. A. K. Huntington presided.

The two sections of the paper are entirely distinct. The first part, which illustrates in a very striking way the commercial value of the application to practical needs of familiar scientific laboratory methods, is a description of the plant which has been designed by Mr. Rhodin for the rapid and accurate analysis of an immense number of specimens of Muntz's metal. This well-known alloy of copper and zinc should contain from 60·5 to 61·5 per cent. of copper, the extreme limits allowable being a minimum of 60, and a maximum of 62 per cent. An alloy containing over 62 per cent. is useless for practical purposes since it cannot be rolled hot. Why this is the case appears to be the subject of some dispute. Prof. Huntington, who appealed to the exhaustive study of the copper-zinc series recently made by Mr. E. S. Shepherd (see *Journal of Physical Chemistry*, 1904), ascribed this peculiar property merely

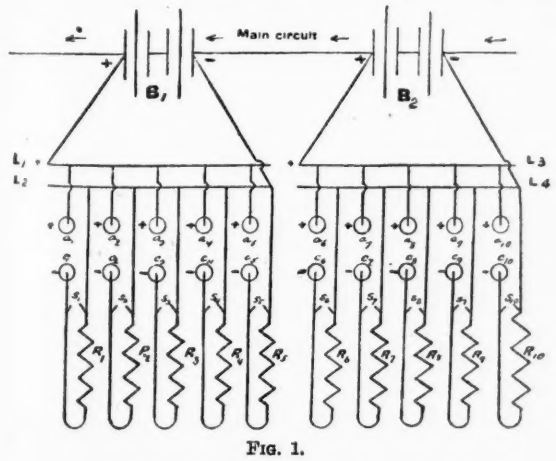


Fig. 1.

to the presence of the compound Cu_2Zn, but Mr. Rhodin maintained that a Muntz's alloy of far higher copper content than 62 per cent. can be rolled hot, provided the constituents are absolutely pure. Anyhow, whatever the ultimate cause of the trouble, in practice the constituents are *not* pure, so 62 per cent. remains the upper safe limit for copper content. On the other hand, metal with less than 60 per cent. of copper behaves towards sea-water in a way which is highly undesirable. Muntz's metal is largely used in shipbuilding as a sheathing to protect woodwork against the action of certain mollusca and algæ. To be of any value it must dissolve in sea water to just a sufficient extent as to render the surface poisonous, and in order that the life of the sheathing may be as long as possible, the two constituents should dissolve at precisely the same rate. Now this, the alloy containing less than 60 per cent. of copper does not do, there being a preferential dissolution of zinc which occurs very rapidly. It is, therefore, most important that every "heat" of metal (of which there are some 40 to 60 every 24 hours) should be analysed within 12 hours of casting, and with a mean probable error not exceeding ± 0·1 per cent. It is not only that the analyses determine what previously used to be tested only by the crude method of rolling, whether the product is of any value, but they also act as infallible guides to the judgement of the men whose duty it is to add the spelter (which is burning away continuously) to the molten copper, and the result of this analytical control has been that the most desirable composition has been obtained in over 80 per cent. of the "heats" made, while in less than 2 per cent. of the cases only has it been necessary to remelt the product.

Having explained the necessity and value of Mr. Rhodin's innovation, we must now briefly describe his analytical plant, which of course is electrolytic. It consists of 30 unit copper-deposition cells divided into independent sets of five that are connected to common leads. Each of these six sets of leads is coupled, through

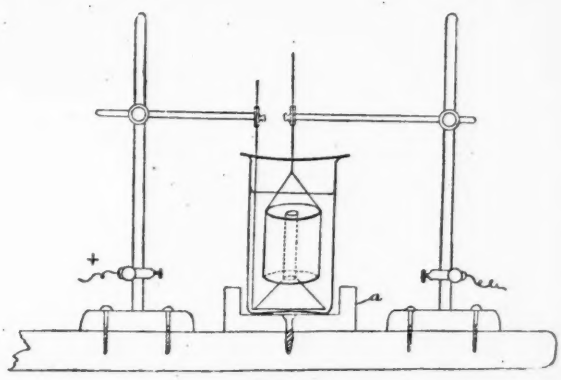


Fig. 2.

nickelin resistances, to two chloride accumulators in series, as shown in the accompanying diagram, fig. 1. Generally speaking, only 25 of the cells are in use at any one time, and as three sets of analyses can be easily made in twenty-four hours, the capacity of the plant is some 75 determinations a day.

Fig. 2 shows a unit cell. The electrodes consist of very fine platinum wire-gauze, 90 meshes to the inch, supported by a framework of stout wire, which also ensures even current distribution, and so shaped, as shown in the figure, that the cathode can easily be removed for the purpose of weighing the deposit without otherwise disturbing the cell. The cathode has a diameter of 5 cms., and the anode of 1·6 cms., the effective height of each being 6·5 cms., and the containing vessel is a 500 cc. Jena beaker. There is a simple and ingenious improvement in the electrode holders over the ordinary Classen type, in that the supporting wires are held in a clip instead of merely by the point-contact of a screw. To make an analysis, one gramme of the alloy is dissolved in strong nitric acid, the whole made up to a bulk of 300 cc., and the current started. Two currents are employed, 0·5 ampere or 2·0 amperes; in the latter case complete deposition takes only three hours, and as the solution is a nitric one, the deposit is perfectly reguline and adherent. It has been objected by some eminent electrochemists that it is impossible to obtain perfect electrolytic separation of copper from zinc, but Mr. Rhodin pointed out that deposition occurs in three phases:—(1) Copper deposition and ammoniacal reduction of nitric acid; (2) ammoniacal reduction only; (3) deposition of zinc, and that if the cathode be removed during the second of these phases, which occupies a considerable time, a perfect separation is possible. Impurities such as arsenic or nickel must, however, be removed by chemical means.

If the first part of Mr. Rhodin's paper is of more practical importance, the second part with the appendix, which is an original study of the dissolution-velocities of binary alloys, and in particular of Muntz's alloy, far exceeds it in theoretical interest. We have already stated that the constitution of Muntz's metal must be such that its components dissolve in sea water at precisely the same rate. Mr. Rhodin supposes that the electrolytic dissolution rate of each metal is directly proportional to the heat of formation of the compound produced, and to the electrical conductivities of the metal itself.

Thus, suppose x to be the required percentage of copper present—

Then $100 - x$ will be the corresponding percentage of zinc.
The molecular heat of formation of Cu_2Cl_2 is + 35·4 calories.
" " " " $ZnCl_2$ is + 113·0 calories.
The specific conductivity of copper (per unit mass) is 6·24.
" " " zinc " " 2·37.
Then, on the above assumption—

$$\frac{x}{100 - x} = \frac{2(35{\cdot}4 \times 6{\cdot}24)}{113{\cdot}0 \times 2{\cdot}37},$$

whence $x = 62{\cdot}30$ and $(100-x) = 37{\cdot}70$. If it be supposed that $CuCl_2$ forms, instead of Cu_2Cl_2, the figures become

$$x = 59{\cdot}33, \text{ and } (100-x) = 40{\cdot}67.$$

It may be assumed that as the oxygen in sea-water varies very considerably, sometimes the one and sometimes the other reaction takes place, and the best mean value for Muntz's metal would be 60·81 per cent. of copper and 39·19 per cent. of zinc, numbers which agree remarkably with those obtained in practice, as already mentioned. It has also been observed that for tropical waters, which contain less oxygen and more reducing organic matter, thus favouring the cuprous reaction, a higher percentage of copper is necessary, whereas for temperate and arctic waters a less rich alloy stands very well. The old theory of structural peculiarities as the cause of the peculiar properties of Muntz's metal falls to the ground from the reason that the dissolution is truly electrolytic, thus depending upon impacts of ions or magnitudes infinitely smaller than the component parts of the structure of the alloy.

The author is now engaged in exhaustively investigating the absolute dissolution velocity of pure Muntz's metal (made from electro-deposited constituents) at a definite temperature, and he read at the meeting an appendix which was not included in the printed paper, containing a preliminary description of these experiments.

The apparatus used, which was shown at the meeting, consisted essentially of a vessel of test-tube shape, with a side tube for introducing the wires to be dissolved, and to receive the stopper belonging to a levelling vessel. A eudiometer tube for measuring the volume of gas evolved was fused to the test-tube, and in view of the importance of keeping the temperature constant, this dissolving vessel was surrounded by a large quantity of water, and heated by gas regulated by a thermo-regulator, which kept the temperature of the bath constant to 0·1° C. The solvent used was fairly concentrated hydrochloric acid (10·037 N), and the temperature—in order to make the action commensurable—80° C. The hydrogen was collected over caustic potash, to eliminate the partial pressure of the HCl gas. As a general result of these preliminary experiments, it appears that a binary alloy like Muntz's metal dissolves slowly at first, the velocity then quickly arrives at a maximum, then it falls suddenly—remaining almost constant for some time—and, finally, a more or less rapid fall again occurs. During the period of constant velocity the surface must alter as the resistance capacity, if the action is galvanic. The seat of E.M.F. must be in the electrolyte, as the constancy of action indicates a steady E.M.F. of considerable magnitude. It is probable that the result is influenced by the actual mass of metal present, relative to that of the solvent. The external pressure exercises a very considerable effect on the reaction-velocity, by influencing the speed with which hydrogen can leave the surface of the metal. In one experiment described, the lowering of the pressure from 758 mm. to 595 mm. increased the mean velocity of dissolution by more than 50 per cent; the magnitude of the influence is, as the author pointed out, very surprising. We look forward with great interest to Mr. Rhodin's promised future communications in so entirely novel a field of electrochemical investigation, and one which has so direct a bearing on the many practical problems bound up with the subject of the dissolution of metals or alloys.

The Faraday Society is nothing if not catholic. Mr. Rhodin's communication was followed by a paper entitled "The Equilibrium between Sodium Sulphate and Magnesium Sulphate," contributed by Mr. R. Beckett Denison, and finally Mr. E. Kilburn Scott—on the eve of his departure for Australia—gave a short abstract of a paper on "Refractory Materials for Furnace Linings," which dealt principally with carborundum, siloxicon, and electrically-shrunk magnesite. As the paper had not yet appeared in type, and as, moreover, the hour was very late, the discussion was postponed, so we hope to return to the subject on a future occasion.

The next meeting of the Society, which will be preceded by the annual general meeting, is to be devoted to the reading and discussion of a paper by Mr. F. W. Harbord on "Electric Steel Smelting." It will be remembered that Mr. Harbord was the metallurgist to the Commission recently sent to Europe by the Canadian Government, for the purpose of reporting upon the different electro-thermic processes of iron and steel smelting in operation in Italy, France and Sweden.

ACYCLIC (HOMOPOLAR) DYNAMOS.

THE above is the title of the paper read on 27th ult. by Mr. J. E. Noeggerath, before the American Institute of Electrical Engineers, to which we referred in our last issue. The author pointed out that acyclic generators could be classed mainly under two heads—the radial and the axial types—according to the position of the armature conductors. Various forms are shown in the accompanying figures 1 to 4, the positions of the brushes being indicated diagrammatically. Fig. 5 represents the type dealt with in the paper, the armature consisting of a solid cast-steel cylinder, carrying on its surface a small number of conductors connected at both ends to sets of collector rings. The field is of cast-steel, with coaxial field coils, as shown in the figure. There are two sets of brushes, to which access is gained through openings in the frame, and the brushes are connected in series by means of stationary conductors.

The course of the magnetic flux is shown in fig. 5 by dotted lines; the E.M.F. generated in each armature conductor is constant in magnitude and direction, the field being uniform, and the total E.M.F. is given by—

$$E = 1{\cdot}66\ \phi\ N\ n\ 10^{-10},$$

where ϕ = total flux, N = r.p.m., and n = number of armature conductors in series.

Fig. 6 is a section of the machine at right angles to the axis, showing the direction of the field by radial lines.

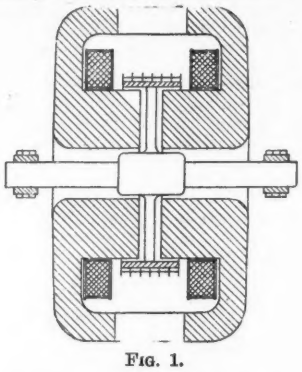


FIG. 1.

Fig. 7 represents the simplest form of circuit in a machine of this kind; C is one of the armature conductors, R one of the stationary or frame conductors, and C_r, B, the collector rings and brushes. The reactions set up by the currents flowing in this system are of two kinds—those due to the straight conductors, and those due to the rings. The latter are of especial interest and importance.

It will be seen that currents flow in the left-hand ring both ways from P_1 to B_1, inversely proportional to the resistances of the two paths, which are continually varying in length, and these currents

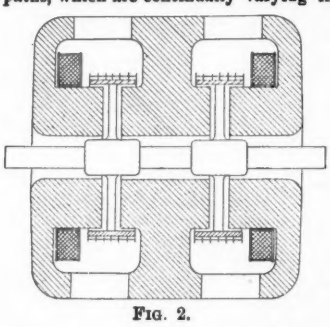


FIG. 2.

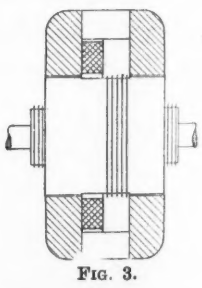


FIG. 3.

give rise to magnetic fluxes in the solid steel by which they are surrounded. The variation in magnitude and direction of the resulting magnetisation is necessarily accompanied by hysteresis and eddy currents in the steel, and also weakens the main field. It could be done away with by placing brushes all round each ring, but this is not a practical solution of the problem. The difficulty has been completely overcome by making the connections (P_1, P_2, &c.)

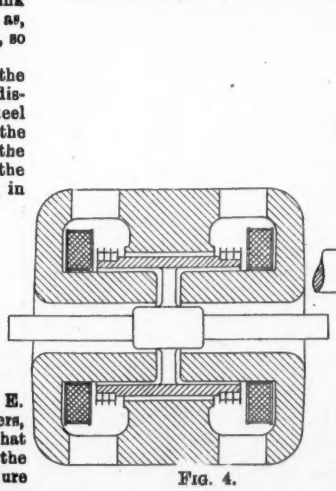


FIG. 4.

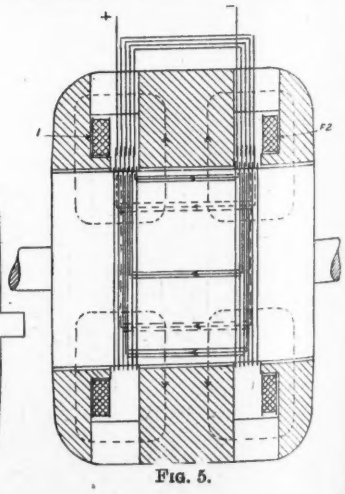


FIG. 5.

between the armature conductors and the rings (B_1, B_2, &c.) follow a spiral of one complete turn, while the brushes (B_1, B_2, &c.) follow a spiral of one or more turns in the opposite direction.

The currents in the straight conductors, C, set up secondary fluxes, indicated by the curved lines in fig. 6, which pass through the frame as the armature revolves and give rise to losses, besides, on the whole, weakening the main field. By placing the conductors close together, or preferably by using broad flat conductors closely opposed, the radial components of these fields are neutralised. The

resultant secondary field, indicated at B, fig. 6, is circular, at right-angles to the main field, tending to increase the path of the main flux, and, on the whole, to weaken it. When the armature and

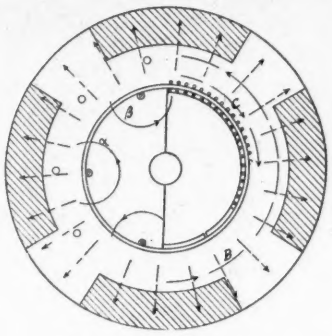


FIG. 6.

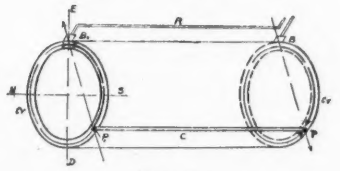


FIG 7.

frame conductors are kept close together, as at A, fig. 9, the reaction is insignificant; but when the space between them is filled with steel, as at B or C, fig. 9, the reaction is appreciable, but can be kept low.

Various ways of compound winding are available. The connections between the stationary conductors and the brushes, for

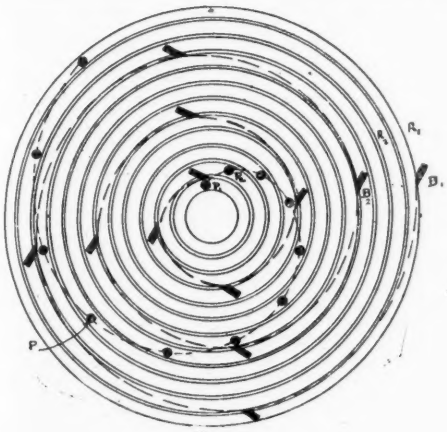


FIG. 8.

example, may be arranged as in fig. 10, so that the currents in them assist or oppose the field currents, and then, by shifting the brushes, it is obviously possible to vary the E.M.F. at will and to adjust the

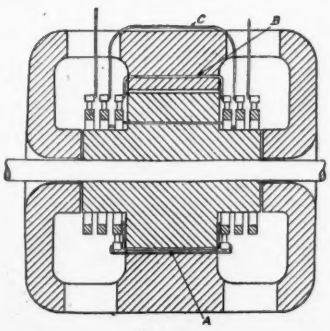


FIG. 9.

compounding; or the armature conductors may be shaped, as in fig. 11, to give a fixed compounding. It follows that series generators and motors can be built without field coils, and if the arrangement of fig. 10 is used, the direction and magnitude of the E.M.F. of a generator can be controlled by shifting the brushes, while the speed, torque and direction of rotation of a motor can similarly be varied. Fig. 12 shows how easily the generator can be used on a three-wire system.

The design of a radial type of acyclic generator is generally similar to that of the axial type, with suitable modifications. The efficiency of the machines is about the same as that of a turbine-

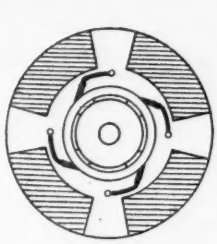


FIG. 10.

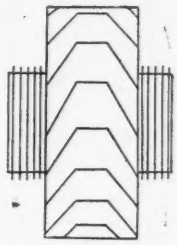


FIG. 11.

driven commutating dynamo, but the C^2R losses in field and armature are small, as also are the hysteresis and eddy losses, provided that the fields (including leakage fields) are all uniformly distri-

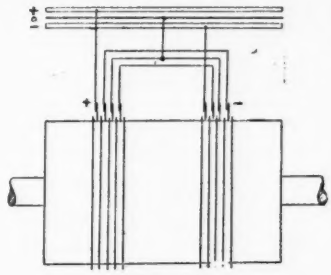


FIG. 12.

buted round the circumference of the armature. The principal losses are due to friction and pressure drop at the brushes.

The variation of the losses and the temperature of the ring with speed is shown in fig. 13, and the variation of the pressure drop with

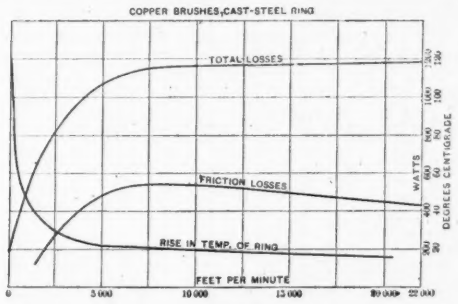


FIG. 13.

current density in fig. 14. Some resemblance between the behaviour of the rubbing contacts at high speeds and that of the electric arc is traced; for example, it often happens that pressures 10 or 20 times the normal are required to start the flow of current. Increase of pressure on the brushes has little effect on the drop; but high pressures are necessary on account of a tendency to sparking at high speeds and current densities.

In the case of the 300-KW. 500-volt turbo-generator which has been tested, the full-load losses, without windage and bearing fric-

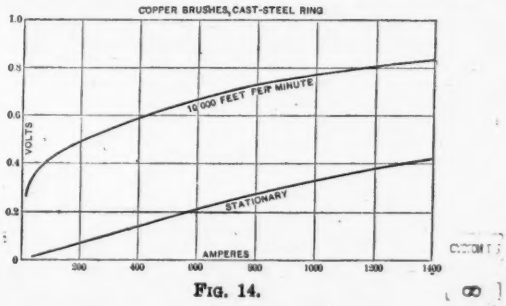


FIG. 14.

tion, were 28 KW. The efficiency curve, fig. 15, is remarkably flat, and the regulation is 6 to 12 per cent. The armature and frame are of cast-steel, the former having 24 conductors*—flat sheets,

* Elsewhere it is stated that there are 12 armature conductors and 12 frame conductors in series.

bent to fit the smooth surface. The conductors are driven by lugs projecting from the armature body, and are held in place by steel binding wires. There are 12 collector rings at either end of the armature, assembled close together and mounted on a shell, and 24 brushes, to which access is gained through eight openings in the

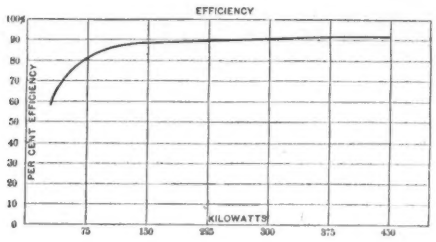


Fig. 15.

frame. The total weight of the machine is about the same as that of the ordinary type, but the very low copper weight and simple construction of the acyclic type, and the absence of commutation troubles, are in favour of the latter.

TRAMWAY CONSTRUCTION AND EQUIPMENT.

The following is a copy of a memorandum on details of construction and equipment, which has been issued by the Board of Trade, relating to tramways and light railways laid on public roads:—

1. *Clearance.*—The space between the inner rails of a double line must depend upon the overhang of the cars. It is, however, necessary that there should be at least 15 in. between the sides of passing cars and also a similar space between the side of a car and any standing work such as lamp, telegraph and trolley wire posts in a street. There should be at least 15 in. between the side of a car and the kerb, whether on straight or curved roads. The clearance between the top deck of cars and the under-side of bridges should not be less than 6 ft. 6 in.

2. *Posts and Brackets.*—Centre posts should not be used without the consent, in every case, of the Board of Trade. The stone kerbing round centre posts should not be such as to enable any person to stand upon it as a refuge, unless the clearance is ample for safety. Where bracket arms 16 ft. in length will not suffice, it is desirable that span wire construction should be used.

3. *Permanent Way.*—The weight of rails should not be less than 90 lb. per yard, 100 lb. being preferred. The groove of the rail should not exceed 1⅛ in. in width, but a groove not exceeding 1¼ in. will be accepted on curves of less than one chain radius. The details of permanent way and mode of construction as approved by the Board of Trade should not be varied at any time without the Board's consent.

4. *Cars.*—Staircases of the "reversed" type should be avoided, more especially on narrow gauge lines. Of existing types the "trigger" lifeguard is the pattern which is preferred. The hanging gate should be as close to the ground as possible, and there should be at least 3 ft. between it and the front of the guard. Both the guard and the gate should be at least as wide as the outside of the frame of the truck. In order not to interfere with the efficiency of the lifeguard, it is desirable that folding steps should be adopted on all new cars. The use of covers for the top deck of cars cannot be approved in cases where the gauge of lines is 3 ft. 6 in. or less. Top deck railings should be at least 3 ft. 6 in. high. The trolley standard must be connected with earth by a low resistance fuse or automatic switch, and the warning signal, when the fuse or switch opens, should be an electric bell. Where trolley ropes cannot be dispensed with or tied up, precautions must be taken to prevent the "slack" causing accidents. To prevent trolley booms being pulled out or trolley standards broken, "traps" should be minimised and detachable trolley heads provided. No material alterations should be made in cars after inspection, nor any fresh type of car adopted, without the consent of the Board of Trade.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

1,243. "An improved clip or apparatus for the screwing up or the removal of the nut or ring used for securing the shade or reflector to electric lamp-holders." J. Parry. January 23rd.

1,247. "Improvements in conduits for the protection of electrical conductors." D. Maxwell. January 23rd.

1,249. "Electric relay with time control for closing circuits of electro-magnets." J. Ferguson and Kelvin & J. White, Ltd. January 23rd.

1,281. "Improved devices for use in controlling polyphase and alternate current motors." Siemens Bros. & Co., Ltd., and H. Berry. January 23rd.

1,299. "Improvements in or relating to apparatus for use in recording telephonic messages or sounds." H. Starcke. January 23rd. (Complete.)

1,300. "Improvements in or relating to electric switches, controllers and the like." A. B. Soar and H. F. Joel, Jun. January 23rd.

1,313. "Improvements in electric meters." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) January 23rd.

1,321. "Improvements in and relating to railway electric signals." S. W. Huff. January 23rd. (Complete.)

1,324. "Improvements in terminal rods or conductors of sparking plugs for internal combustion or explosion engines." F. R. Simms and R. Bosch. January 23rd. (Complete.)

1,360. "Apparatus for producing electric arc sparks or flames for bleaching or sterilising purposes." W. Cramp. January 24th.

1,380. "Improvements in telephone selecting mechanism." W. D. Watkins, J. W. Bolster and W. E. Goodsell. January 24th. (Complete.)

1,384. "Improvements in electric apparatus for felling trees or sawing wood." T. O. Wilson. January 24th. (Date applied for under Patents Act, 1901, January 30th, 1904, being date of application in United States.) (Complete.)

1,391. "Improvements in systems of electrical distribution." R. P. Jackson. January 24th. (Date applied for under Patents Act, 1901, June 6th, 1904, being date of application in United States.) (Complete.)

1,400. "Improvements in incandescent electric lamp sockets." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) January 24th.

1,406. "Improvements in and relating to the manufacture of plates for secondary electric batteries." L. N. J. Roselle. January 24th.

1,407. "An improved process of and apparatus for the manufacture of plates for secondary electric batteries." L. N. J. Roselle. January 24th.

1,421. "Improvements in or relating to the manufacture or production of carbons suitable for use in electric arc lamps. V. B. Lewis. January 24th.

1,432. "Improvements in and relating to telephone directories. C. A. Pomeroy. January 24th. (Complete.)

1,482. "Improvements in electrical contact makers and breakers." P. W. Noble. January 25th.

1,507. "Improvements relating to electrodes for arc lamps." H. H. Lake. (La Compagnie Générale d'Eléctricité, France). January 25th. (Complete.)

1,522. "Improvements relating to distributing boards for electric installations." F. H. Headley. January 25th.

1,526. "Improvements in or relating to coils or windings for transformers and other electrical apparatus." A. F. Berry. January 25th.

1,552. "Electric fans." W. Fairweather. (Diehl Manufacturing Co., United States.) January 26th. (Complete.)

1,553. "Method of drying hygroscopic insulation of electric conductors." G. H. Nisbett. January 26th. (Complete.)

1,557. "An improved method of utilising and transmitting power in bicycles and other reciprocating prime movers." J. Dinsmore, Jun. January 26th.

1,559. "Improvements in gas lamps and electric lamps." J. B. Colbran. January 26th.

1,563. "Improvements in electrical measuring instruments." M. B. Field. January 26th.

1,580. "Improvements in, and relating to, electric train lighting systems." The Union Elektricitats-Gesellschaft. (Date applied for under Patents Act, 1901, January 27th, 1904, being date of application in Germany.) January 26th. (Complete.)

1,592. "Improvements in, and relating to, brush-holders for dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) January 26th.

1,607. "Alarm fuse for telephone exchanges." E. B. Craft. (Date applied for under Patents Act, 1901, February 5th, 1904, being date of application in United States.) January 26th. (Complete.)

1,637. "An electro-magnetic purifier for use in milling." J. L. Lawson. January 27th.

1,638. "Improvements in, or relating to the 'party line' system of telephones." H. B. Stocks. January 27th.

1,658. "An improved electro-magnetic switch for use in connection with electric railways on the sectional conductor system." E. Fenton. January 27th.

1,670. "Improvements in alternating electric current motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) January 27th.

1,681. "Improvements in insulators for electric conductors." Marconi's Wireless Telegraph Co., Ltd., and G. E. Turnbull. January 27th.

1,710. "Improvements in electric incandescent lamps." C. J. Hall and F. J. Anson. January 28th.

1,732. "Improvements relating to controller and brake mechanism for electrically-driven road vehicles." S. A Russell and E. Ford. January 28th.

1,756. "Improvements in and relating to electric time switches." N. de Maid Watsham. January 28th.

1,399. "Electric governor." J. R. F. Smith. January 24th.

1,754. "Improvements in electric ignition devices for explosion engines." H. de la Valette. (Date applied for under Patents Act, 1901, January 28th, 1904, being date of application in France.) January 28th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

Electrical Separation of Granular Materials. F. O. Schnelle. 13,489. June 14th.

Electric Cables working with High Voltage. Siemens-Schuckert Werke. 14,568. June 28th.

Prevention of Fires caused by Short-Circuits. O. Wilhelm. 15,551. July 12th.

Indicators for Telephones. F. Drowns. 16,509. July 26th.

Gas or Vapour Electric Apparatus for Use as Lamps, and for other Purposes. S. E. Flichtner. 17,166. August 5th.

System of Electric Lighting for Railway Trains. H. Pieper and G. L'Hoest. 18,322. August 24th.

Indicating Device for Electrical Fire Alarms. R. Hoenicke. 18,383. August 24th.

Electric Temperature Signalling Device. C. Kloppenstein and G. Kloppenstein. 18,827. August 31st.

Electric Time Recording Mechanism. M. Kelly. 18,908. September 1st.

Electrically-driven Fans. F. Reiss and R. Klemm. 19,334. September 7th